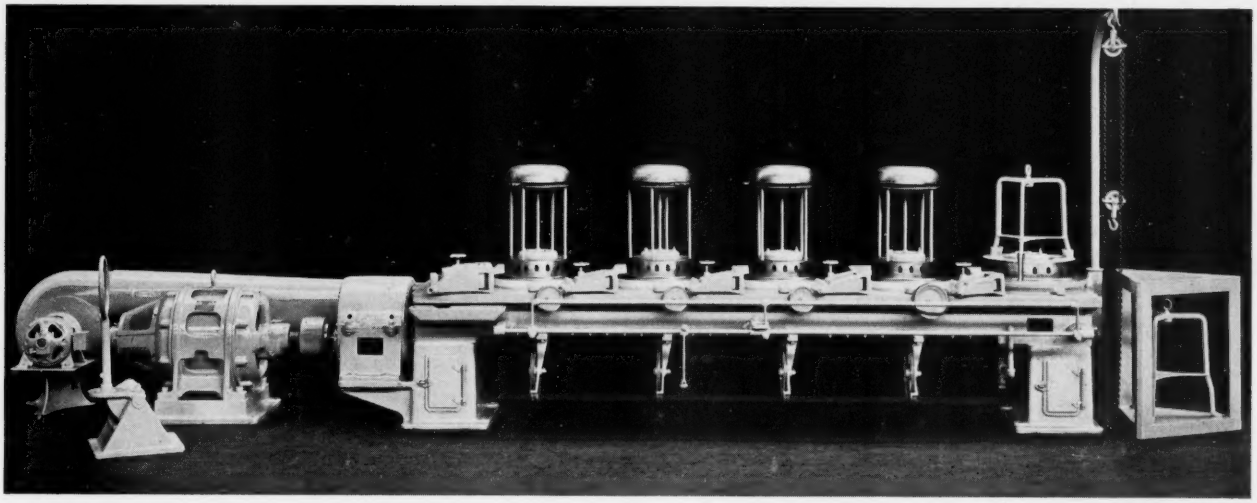
WIRE & WIRE PRODUCTS

OFFICIAL PUBLICATION OF THE WIRE ASSOCIATION



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ROLLING MILLS GAS PRODUCERS WIRE MACHINERY
COMBUSTION CONTROLS

October 1932

Firthaloy Dies may now be identified by this new trade mark on the casing

AN INVITATION

WHEN you visit the National Metal Exposition in Buffalo, beginning October third, drop around to Booth D-23. Users of drawing dies will find in our exhibit of FIRTHALOY DIES evidence of the progress that has been made up to the present time in the development of cemented carbide for dies. Some are shown in section, revealing the principle of the new casing---the most radical improvement in die design that has been made in a long time. New machines especially designed by Firth-Sterling for drilling and polishing cemented carbide dies will also be in operation.

No matter what may be your attitude toward the introduction of new and more efficient dies and equipment at this time, it will pay you to spend a few minutes at our booth and learn what Firthaloy Dies will do for you when you are ready. If you are not going to the Exposition this year, send for our new Firthaloy Bulletin #3--but we hope to see you in Buffalo.

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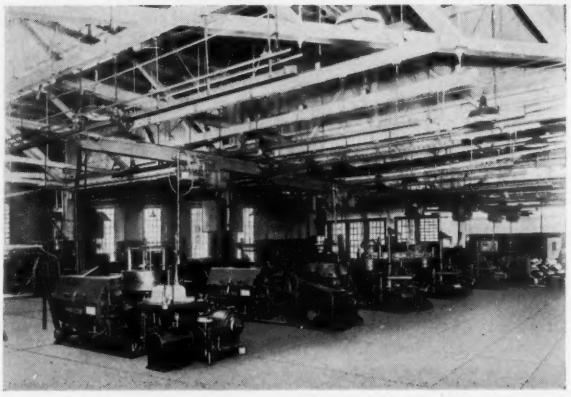

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We have found that the wearing of tungsten carbide is affected very materially by the cobalt content. When this cobalt is increased to the high limit, the wear is about the same as Rãmet but such a die is so extremely brittle it is very apt to crack.

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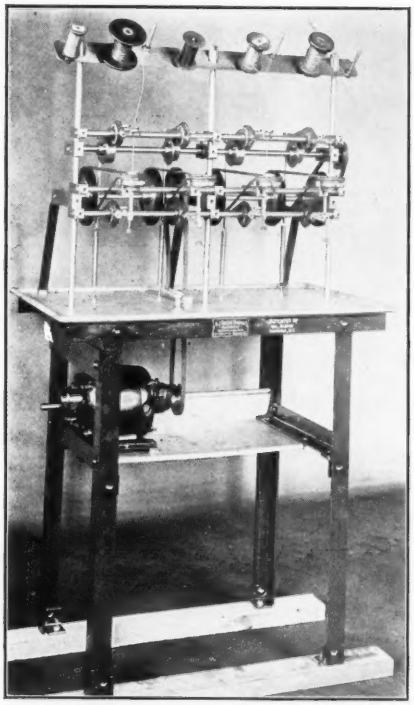

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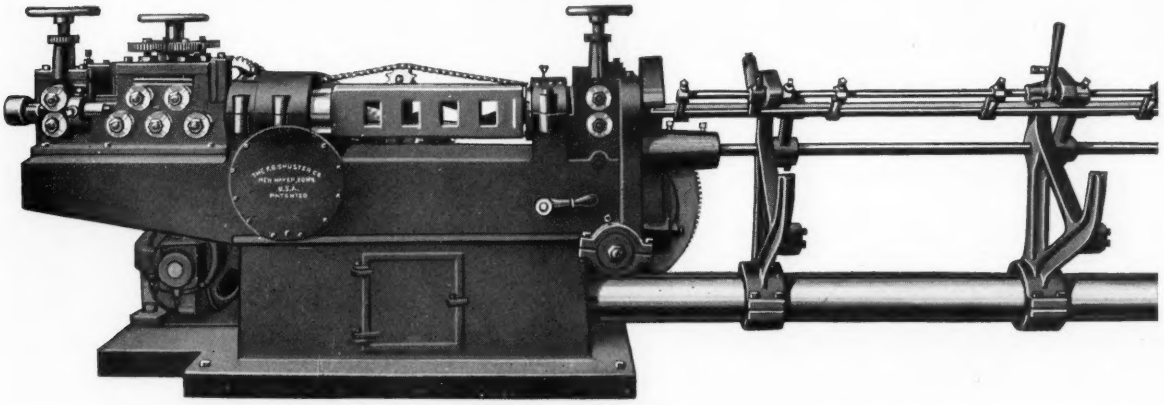

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SIMPLE Machines which may be operated by unskilled labor, showing a handsome profit at the end of the year.

MADE in sizes heavy enough to handle ¾″ diameter and delicate enough to handle 1/32″ diameter.

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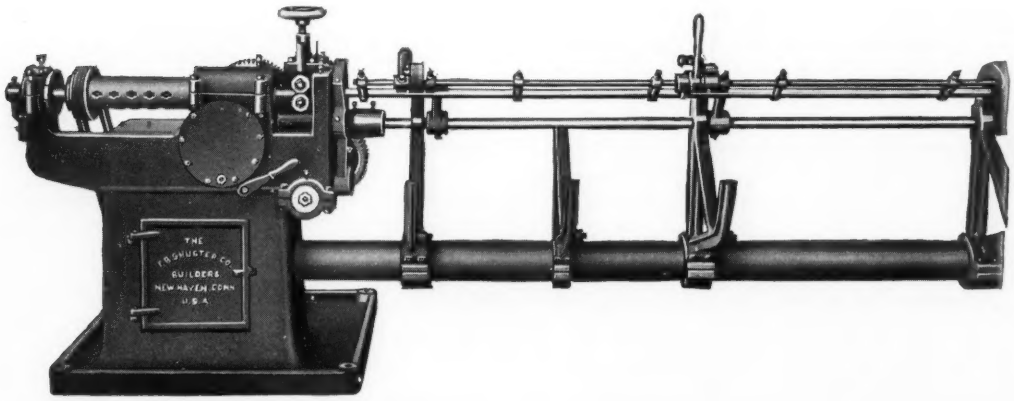

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WIRE & WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip. Wire Products and Insulated Wire and Cable.

DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING.

Vol. 7 October 1932 No. 10

Designated as

Official Publication By The Wire Association

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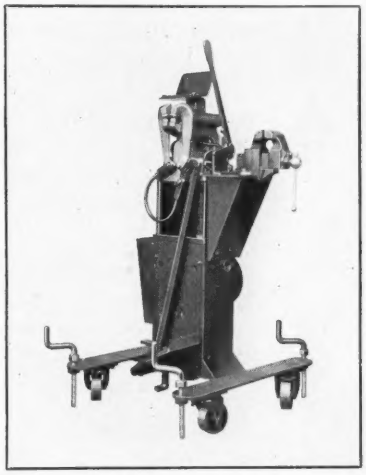

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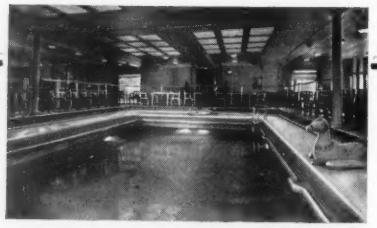
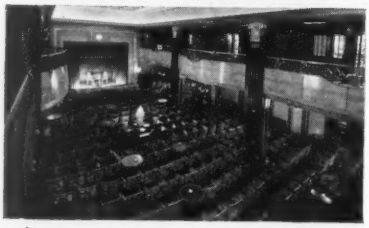
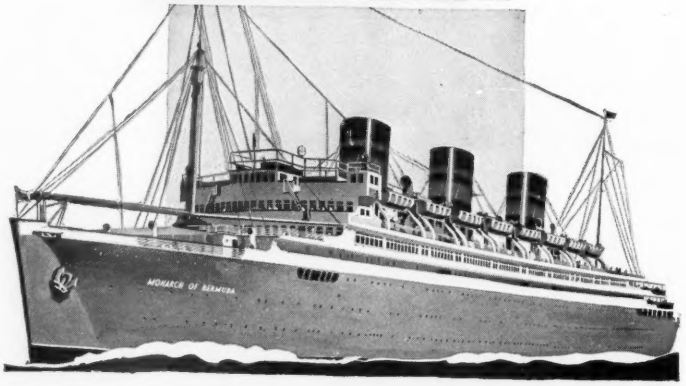
Will the 1933 Convention of the Wire Association be held on ship-board enroute to Bermuda and return?







YES! Say association members who approve the reduction of their usual convention expenses to an all-inclusive fee of fifty dollars.

YES! Say association leaders who approve a dynamic stimulus to increased convention attendance.

YES! Say convention speakers who prefer to address relaxed, rested audiences under ideal conditions of weather and bodily comfort.

YES! Say convention program officials anxious to insure maximum attendance at all sessions.

The American Institute of International Relations hopes—and predicts—that the official verdict of the entire Wire Association at its coming Buffalo convention will also be—

YES!

American Institute of International Relations

1350 BROADWAY, N. Y. C.

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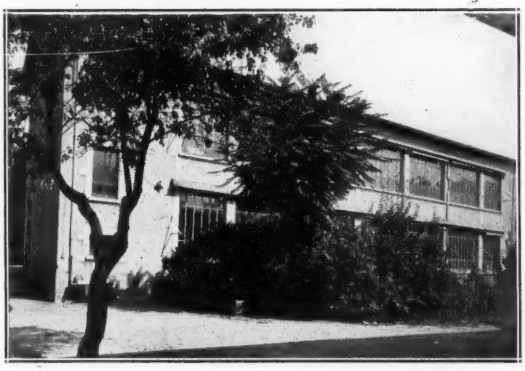
1870 - 1932

The Quality Diamond Dies



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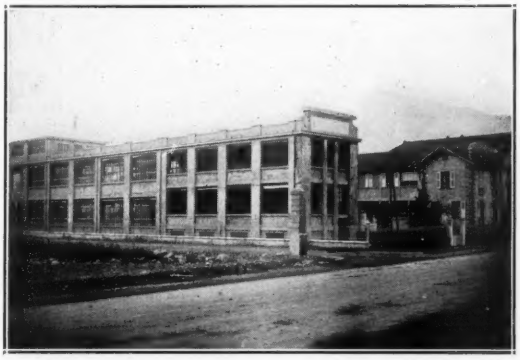

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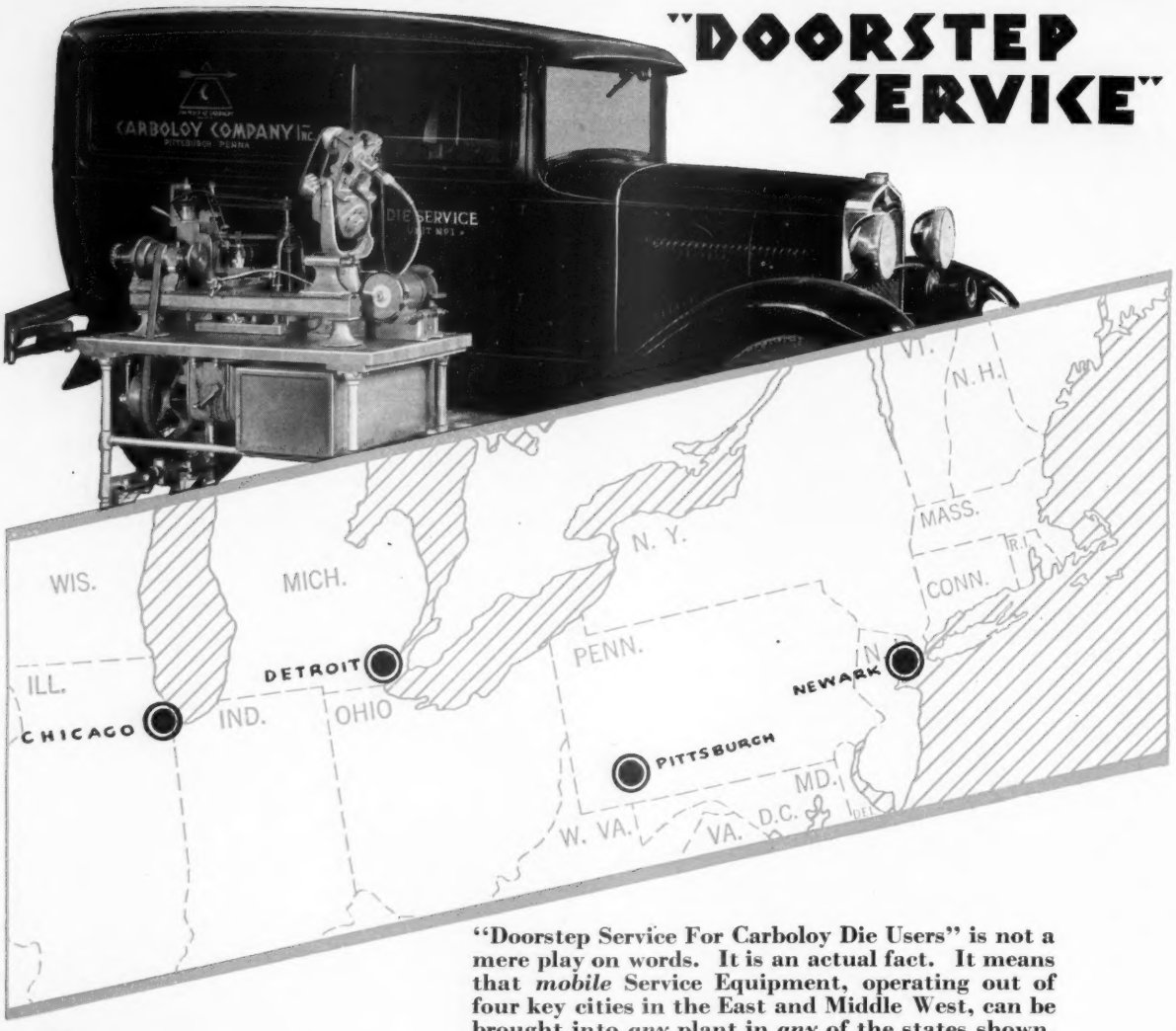

Carboloy *Mobile* Service Units are located in 4 key cities and cover states shown above. The special unit illustrated operates in the Pittsburgh District. It will be on display in Booth F-25, Nat'l Metal Show, Buffalo, Oct. 3-7, 1932.

"Doorstep Service For Carboloy Die Users" is not a mere play on words. It is an actual fact. It means that *mobile* Service Equipment, operating out of four key cities in the East and Middle West, can be brought into *any* plant in *any* of the states shown, for *any* service work required (except sectional and shaped die work).

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CEMENTED CARBIDE DRAWING AND EXTRUSION DIES

WIRE & WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip.
Wire Products and Insulated Wire and Cable.
DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 7 OCTOBER, 1932 No. 10

Wire Drawing as a Handling Problem

By L. D. Granger

Asst. to Vice-Pres. Wickwire Spencer Steel Co., New York, N. Y.

Observations on Different Types of Material Handling and the Effect in Reducing Tonnage Cost. A Paper Presented Before the Wire Association. ▼

WIRE drawing is usually considered as the process of reducing a wire from one diameter to another in one or more drafts. A great deal of time and study has been given to lubricants, dies, speeds, coatings, and all the other details of manufacture, and of late years, a great deal of attention has also been given to the machinery on which this work is done. Very considerable increases in the amounts produced per machine and per operator have resulted. There has also resulted a very decided haze in the minds of many of us who have not had time or opportunity to analyze the various claims of manufacturers, so that we are at a loss to be able to decide for ourselves what type of equipment is desirable, and under what conditions we may best approach the great goal of the manufacturer of today—the lowest cost per ton.

✦ ✦ ✦

THE continuous wire drawing machine manufacturer sees everything possible from a continuous machine standpoint, and the single block manufacturer reduces practices to single blocks, while those of us who use the machinery, listen first to one and then to the other, and probably end by knowing no more than we did before, and perhaps less.

✦ ✦ ✦

WE realize that the first two blocks of a continuous machine run too slow to be efficient,

L. DWIGHT GRANGER

Vice President, The Wire Association
Asst. to Vice-Pres., Wickwire Spencer Steel Co.

but are told that this slow speed is just what the coating needs to prepare it for the faster finishing speeds. We are also told that the extra handling costs on single block equipment over balance the slow speeds, and increase the overall cost. One manufacturer is frank enough to say that the cost of four draft work is just about the same on either form of equipment— and so the arguments are bandied back and forth to our utter confusion.

✦ ✦ ✦

MOST of us are adverse to allowing others to decide our problems for us, and want to know at least how and why the various opinions—which may vary widely —are formed.

✦ ✦ ✦

WE have lost sight, perhaps, of the basic principle of any operation—that the greater the proportion of operating time to total time, the more efficient our process becomes, and to the fact that however widely equipment may vary, its production may always be accurately calculated on the basis of the relative amount of non-productive time. We have installed stripping blocks, and

Designated as Official Publication by the Wire Association

cranes, and done many other things to lessen handling, but there has been very little attention given to the real reasons behind all this to see wherein our development has been logical or otherwise—and to see where the road is leading us as its ultimate destination. We will try to show that the fundamental consideration back of improved practice is the elimination of product-less labor, and that only by this elimination is any increase in production possible.

✦ ✦ ✦

GREAT advances have been made in the handling of materials from the rod pile to the wire mill, and in carrying rods from the cleaning crane to the mill.

✦ ✦ ✦

TO use the picturesque but forceful language of Mr. K. B. Lewis speaking of the old time mill, with frames parallel to the center aisle, backed up against a wall—"In a busy wire mill running at good efficiency, the aisle in front of a rod bench or a row of bull blocks looks like the corner of 42nd Street and 5th Avenue. The nearer the blocks come to a satisfactory efficiency, the greater is the congestion of trucks of raw and finished materials, reels, flippers, pointers, and tractors. Among these obstacles may be observed skipping and staggering about, certain so-called wire-drawers, who are actually porters, truckers, bundlers, inspectors, traffic directors, diplomats and mathematicians."

✦ ✦ ✦

NO matter how efficiently traffic cops may direct the flow, it goes only in one direction at one time, while the cross traffic waits, eating its head off in time and money.

✦ ✦ ✦

AS Mr. Lewis further points out, any type of wire drawing machinery may be so arranged that there are three aisles—one for raw material, one for the operator, and one for the finished product. Thus, while traffic may be enormously increased, congestion is eliminated. This may call for more floor space, but there seems to be no valid reason now for maintaining wire mills in localities of high rentals, and the decrease in lost time, trucking and confusion, would soon repay expense of a considerable increase in floor space.

✦ ✦ ✦

WHEN the entire production of a mill turning out 18 tons of wire an hour can be handled from baker to frames, and from frames to destination by two men, and they working only part time, the value of systematized handling is evident.

✦ ✦ ✦

OVERHEAD handling or ram trucks seem to be the best way to move pins of rods from rod yard through cleaning and baking to drawing frames. Skid platforms and elevating trucks seem to give the best results from the frame on.

✦ ✦ ✦

WE have, however, a very important problem in the efficient handling of the material between these two points—during the wire drawing operation itself—and it is with this point that we are really concerned.

✦ ✦ ✦

WE are therefore to consider wire drawing as a process of moving a mass of material from rod truck to wire buggy, the reduction in area being an entirely secondary consideration.

✦ ✦ ✦

THE problem in its simplest phrase is for one draft work, and increases in complexity as the number of drafts increases.

✦ ✦ ✦

ONE draft work is comparatively simple, yet let us consider an old time mill with its modern competitor.

✦ ✦ ✦

THE rods come out of the baker on a truck—this truck is pushed up the aisle by the main strength of from one to three laborers, the truck is dumped, and the rods lie in more or less orderly pile back of the frame. The wire drawer disentangles a bundle, rolls it over to the swift, unsnarls the starting end, pulls out enough to reach the pointer, points, coils back the end on the swift, and starts the bundle through the die. After the draft is done, he pulls out two pins, pulls the coil to the front of the block, puts on a couple of tie bands, and lifts the bundle to the truck.

✦ ✦ ✦

HERE are seven handlings—from the dry house onto the floor, from the floor to the swift, pointing, stringing, pulling over, tieing and lifting.

✦ ✦ ✦

THE conveyor type wire mill on the other hand has the rods on a pin that serves as a flipper reel, so that the dumping and placing on swift are eliminated; the rods are pointed, strung, drawn, and the bundle lifted from a stripper block by a crane onto the truck—three operations and practically no physical effort as against seven operations, and a Sandow's job for three hundred pound bundles.

✦ ✦ ✦

AS the drafts increase, the complications of the old frame practice also increase, and the wire drawer becomes a mathematician when he tries to figure out what drafts to draw on which blocks.

✦ ✦ ✦

IN drawing 4 holes to 14, a common practice is 8½-10¾-12½-14, and usually 5 blocks are provided.

A little calculation shows the following:

Draft	Ft. per Lb.	Blocks Necessary
8½	15.6	.55
10¾	24.8	.90
12½	39.0	1.41
14	58.6	2.14
Total	138.0	5 00

✦ ✦ ✦

IN other words, to draw one pound of .080 wire 138 feet of wire of one size or another must go through the dies, and, for greatest efficiency the block time for each draft must be in the proportion shown.

✦ ✦ ✦

IN other words, to draw one ent college graduate to work out just how many blocks should be used on each draft every hour in the day to make the most wire, but we expect the wire drawer to do it as matter of course. No wonder the productions of various men vary so widely!

✦ ✦ ✦

WHEN you look at it from this standpoint, and see how easy it is for the wire drawer to be inefficient—how hard it is for him

to sense just when to double back the second draft on the ripping block, you should begin to think how this source of inefficiency may be removed.

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IF we could arrange all four dies in a continuous line, and make all the reductions at once it would be very fine, but unfortunately the wire would not stand the pull. The next best thing would be to wind the wire around a drum a few times, then through the second die, and around another drum, just as some of our men used to do on frames. This could be developed for three or more drafts until the final draft was reached, when the wire would be coiled up on the finishing block, thus avoiding lifting between drafts. This has been done for a long time on fine wire where the scoring action of the wire on the drums or liners was not too troublesome. Many planetary gears, friction drives, and other contraptions were built to make the drums travel at the proper speed, but most of them required a mechanic in attendance as well as the wire drawer. Then machines with storage blocks were built which drew the intermediate drafts a little faster than required, and got away very largely from the cutting out of the slip blocks. However, after a while welded bundles of rods came in, and carbide dies were developed so that the storage blocks filled up, and the machine had to be stripped from time to time and started all over again. So the trend turned again to slip rings made of material to resist wear, and the war is still on.

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THE continuous method however is fundamentally sound from our view point of handling, as may be seen from the production records.

✦ ✦ ✦

BOTH single block and continuous machine advocates say fairly enough that there is no "best" type of equipment, and that each mill must be analyzed for the "most suitable" type of equipment. As a measure of suitability they propose just what we are all looking for—the lowest cost per ton, combined with proper quality.

WE will agree then that each mill must be analyzed in order to determine what equipment to install, and it is probable that a custom mill may have some of all types of equipment, while a process mill, drawing wire of more or less standard sizes for nails or fence might concentrate on one type as most desirable.

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BUT how are we to determine this point for ourselves, and not feel that the opinion or recommendation we receive from the manufacturer's salesman is not seen through tinted glasses?

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WE like to do this by dividing the operation into two parts, productive time and servicing time, and comparing the relative amounts of servicing—or non-productive—time required by the various types. This means accurate time studies or a logical analysis of the various operations in handling the wire during the process and a careful estimate of the time thus occupied. This done, the daily or hourly production possible may be closely calculated, and compared for the various types, and the proper type of equipment determined.

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IF we find that the various operations in a cycle require a servicing time of 18 minutes on one type of equipment, and only 7 on another, we infer at once that the second type may be made to produce two and one half times as much wire per hour than the first. A man can take off in a given time only as many bundles as he can service, and it makes no difference at all in his production what type of equipment is used, whether the blocks run fast or slow, or what the size of the wire is, as long as he has enough blocks to work on.

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IF one method requires 18 minutes to service a bundle, and the working day is 600 minutes, it is clear that only about 33 bundles can be serviced a day. If the servicing time can be reduced to 7 minutes, 86 bundles can be handled —over two and one half times as many, and the production increased in proportion. In view of these figures, I think we can agree that handling during this operation is a very important factor.

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SO, in order to compare two types of equipment, we have first to determine how efficiently the necessary servicing may be done, and then to compare the other factors surrounding the proper amount of equipment to produce the amount of wire indicated as possible.

✦ ✦ ✦

THE cost of drawing wire is made up of a number of factors which may be expressed as follows:

K=L+O+M+I+R+E

where

K=cost per unit
L=direct labor cost
O=overhead cost
M=repairs and maintenance on machinery
I=interest on investment
R=rental value of floor space
E=losses, errors and defects.

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ALL of these factors must, of course, be reduced to a unit cost—per ton or per 100 pounds as may be your custom.

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THE direct labor cost is of course the expected earnings divided by the production in any given time. The rest of the factors vary with various plants, and must be determined in accordance with local conditions.

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SO it will be seen that if we determine the values for each of these items either from our own experience or from a guarantee by the salesman, we can decide whether a lower cost installation using more floor space is superior to one costing more, but using less space. Also, we can see whether in some countries where seven cents a day is a fair wage, it would pay to put in expensive machinery, and how much the relative production of scrap influences the cost.

✦ ✦ ✦

THERE is no "best" machine or type of equipment for all purposes—you have to figure out the factors for your own case yourself.

(*Please turn to page 362*)

Copper Rod Rolling, Wire Drawing and Annealing

By John R. McKean

Supt., American Electrical Works, Phillipsdale, R. I.

This paper presents the manufacturing practices of the American Electrical Works, Phillipsdale, Rhode Island, and as all the rod and wire equipment has been installed within the past four years, represents modern practice. ▼ ▼ ▼ ▼ ▼ ▼

THIS paper is presented with the hope that it will provoke round table discussion of problems which are common to all present. On account of the limited time and the comprehensive subject to be treated there may be parts lacking in detail which no doubt will be brought out in the discussion.

THIS paper represents the manufacturing practices as established at the American Electrical Works, Phillipsdale, R. I. and as all of the rod and wire equipment has been installed within four years it is thought represents modern practice.

✦ ✦ ✦

AT the start of a program to remodel the rod and wire departments a study was made of all operations, their sequence, handling problems, cost, etc., and an effort was made to develop a layout of equipment that would reduce handling and costs to a minimum, principally by the elimination of the heavy labor formerly attached to these jobs.

This study developed a layout of equipment such as illustrated in the schematic layout shown in Fig. No. 1.

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Rod Rolling

WITH the cooperation of the copper refineries, bars of copper are piled cris cross in layers of one ton each and shipped to the plant so that they can be handled in ten ton lots to the copper bar storage which is located in the Rod Mill. (Fig. No. 2).

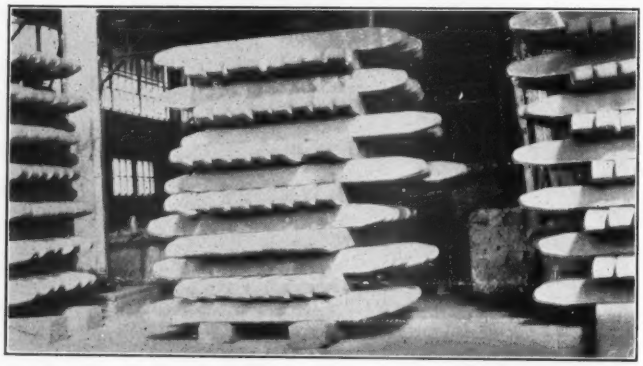

Fig. No. 2—Piled Copper Wire Bars. ✦ ✦ ✦ ✦ ✦

THE rod mill equipment consists of two bar handling cranes, reheating furnace, bar conveyor, roughing mill unit with mechanical manipulator and repeater, intermediate and finishing train. The three mill units are driven by synchronous motors and are fully equipt with anti friction bearings. They are also equipt with a means of water cooling the passes and of removing the copper fumes and scales through tunnels to a settling reservoir where the scales are recovered.

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THE rolling operation consists of reducing a cast copper wire bar of approximately 4"x4½" section to a copper rod suitable for drawing wire. During this operation the crystal structure is changed as illustrated in Figs. No. 4- No. 5.

✦ ✦ ✦

THE copper bars of nominal 250 lb. weight are handled in one ton lots by a jib crane to the charging table at the back of the reheating furnace and are advanced

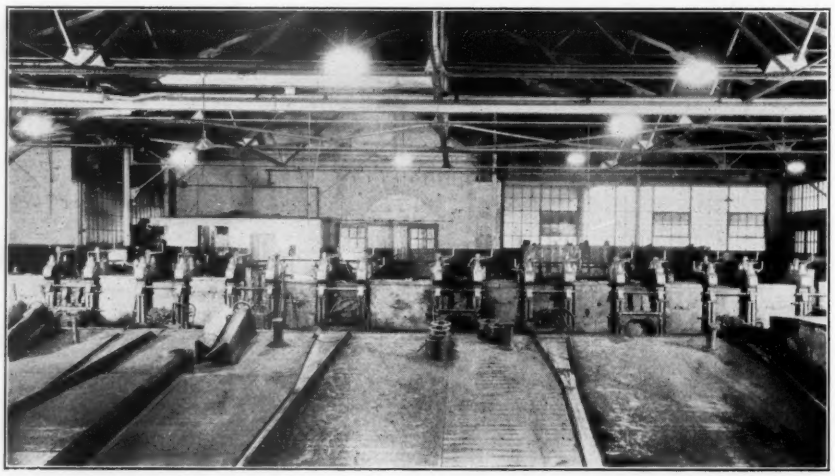

Fig. No. 3—General View of Rod Mill. ✦ ✦ ✦ ✦ ✦ ✦

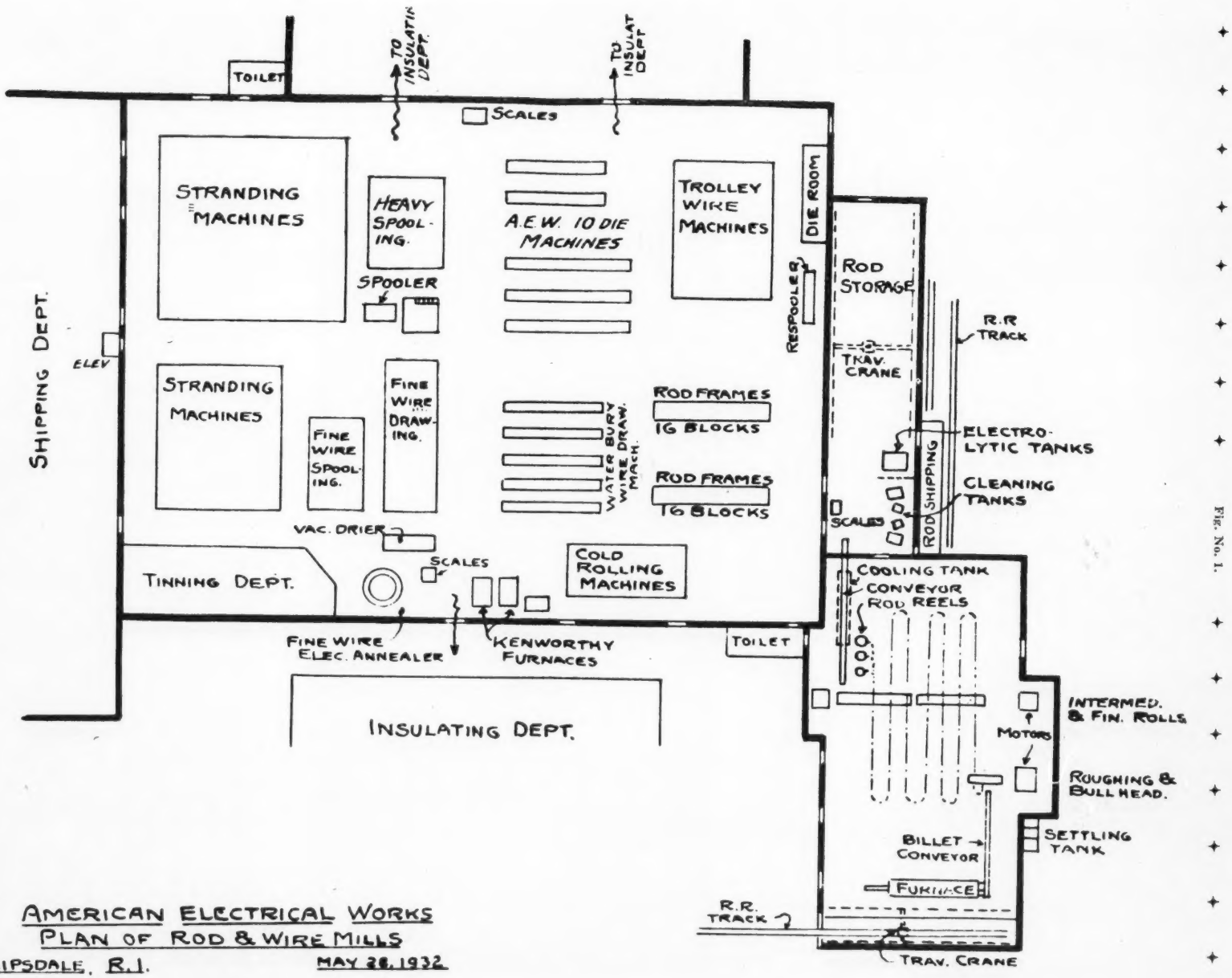

Fig. No. 1.

AMERICAN ELECTRICAL WORKS
PLAN OF ROD & WIRE MILLS
PHILLIPSDALE, R.I. MAY 28, 1932

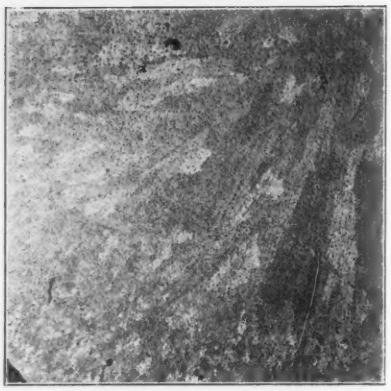

Fig. No. 4—Photomicrographic Section of Copper Wire Bar. Magnified.

through the furnace by a hydraulic pusher operated from the manipulator platform at the rate of rolling. The furnace has a capacity of 110 bars which are heated in three distinct zones until they have reached a rolling temperature.

middle rolls and the bottom and middle rolls. After the bar has passed through its first reduction which is arranged between the top and middle rolls it is manually returned through a pass arranged between the middle and bottom rolls when it is received on a mechanical manipulator and transferred to the third pass which is between the middle and upper rolls again. This operation is repeated six times until the bar is reduced to a one inch square section as it emerges from the last pass of the roughing mill and automatically repeats itself by turning into the bull head rolls from which it emerges as a modified flat oval and is guided down a trough to the first pass of the intermediate and finishing train which consists of nine stands of two high rolls. As

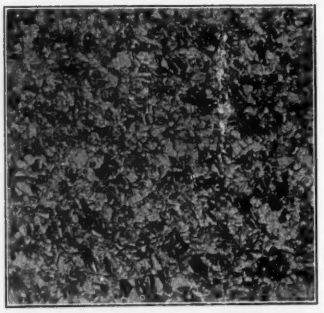

Fig. No. 5—Photomicrographic Section of Copper Rod. Magnified.

tor and passed back through the next set of rolls. This operation is repeated until the rod is reduced through alternate squares and ovals (Fig. No. 6) to the required size of finished rod and emerges from the last pass at 1,870 ft. per minute and at about 1,000°F. passing through a pipe which guides it to the automatic coiler.

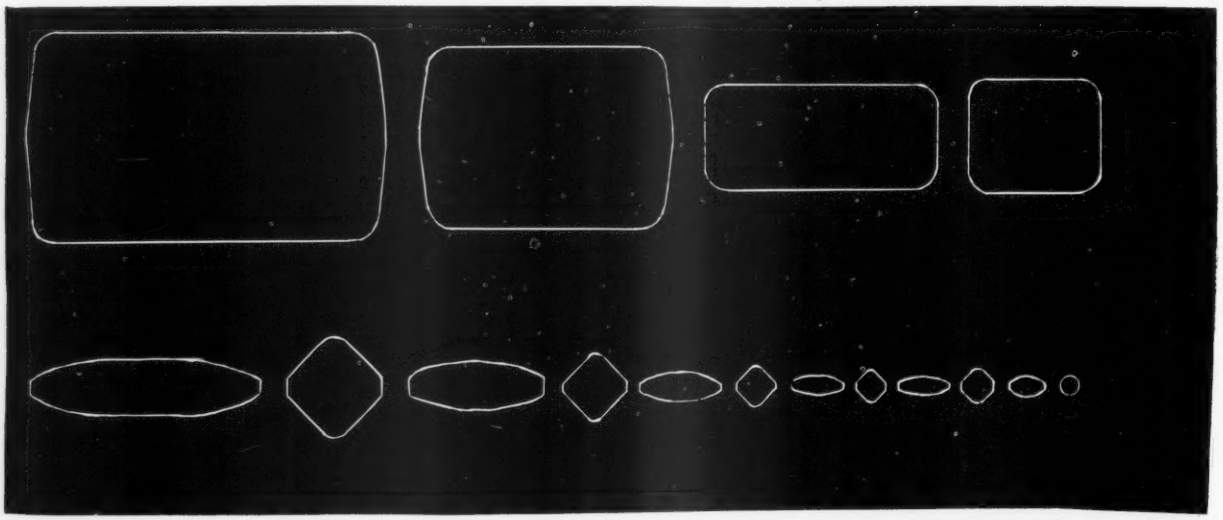

Fig. No. 6.

THE furnace is oil fired, automatically controlled and under the supervision of the roughing mill roller who advances the bars through the furnace as required. The heated bars are discharged from the end of the furnace, having attained a temperature of approx 1600°F., on to a conveyor which carries them to and advances them through the first pass of the roughing mill.

✦ ✦ ✦

THE roughing mill unit consists of a three high stand of rolls motor driven through a set of pinions. The passes are arranged to match between the top and

the rod leaves the 1st intermediate pass it is automatically repeated through the second set of rolls and at this point is caught by a opera-

THE increased length of the rod caused by its reduction during rolling is run out on the looping floors, which are on each side

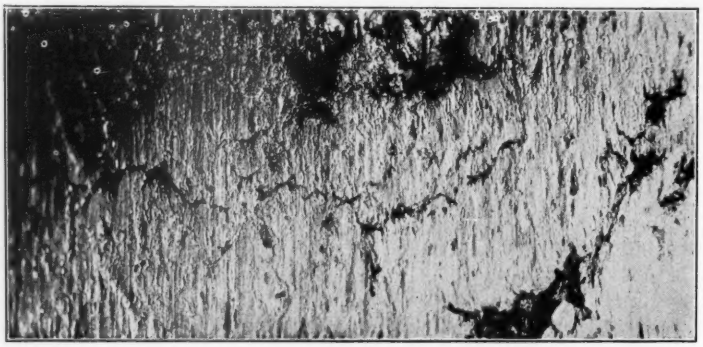

Fig. No. 7—Magnified Surface Showing Cracks.

Fig. No. 8—Seam in Surface of Rod. Magnified 100 X.

Fig. No. 9—Effect of Seam in Rod as Appearing in a Drawn Wire. Magnified 3 X.

Fig. No. 10—Magnified 3 X.

of the mill, and its continued growth limited by the gradual increase in roll diameter which is in effect rolling at a greater foot per minute speed.

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THE advantages gained from the anti friction bearings are reduced power consumption, ease of roll adjustment and in uniformity of rolled section.

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THE number of passes given a rod is dependent on its finished size and are varied from ten for ¾" rod to 16 for ¼" rod and the reductions varied from 40% in the bar section to 10% at the finishing roll.

This operation represents an average production of 12 tons per hour of 5/16" rod running a single line in the finishing mill with a long time average scrap loss of less than ½ of 1%.

SOME of the defects in rolling which can cause defective wire are cracks in the rolled bar section (Fig. No. 7) caused by too low a heat in the bar preventing the metal from flowing during rolling. This defect is very rare as the bar temperatures are so closely controlled.

✦ ✦ ✦

IMPROPER adjustment of the passes and the consequent overfilling may produce seams in the rolled section which are not obvious to the eye in the finished rod, but cause serious trouble in wire drawing. This condition is illustrated in Figs. No. 8 and No. 9.

✦ ✦ ✦

OCCASIONALLY a defect similar to Fig. No. 10 is noted which is the inclusion of iron, steel or other foreign material.

This defect usually results in a break in the wire.

THE rods are removed from the coilers to a conveyor which carries them through a tank of water for cooling in preparation for handling in the rod storage. At the end of this conveyor tie wires are applied to the bundles which are then handled by a crane either to the cleaning tanks or to storage.

The finished rod produced by this treatment is approximately 32,500 lbs, per sq. in. tensile strength and has an average elongation of 39%.

✦ ✦ ✦

Rod Cleaning

WHEN the rods come from the rod mill they are coated with a black oxide and scale which they receive during rolling by contact of the hot copper and air. The equipment of the cleaning house consists of a duplicate unit of acid

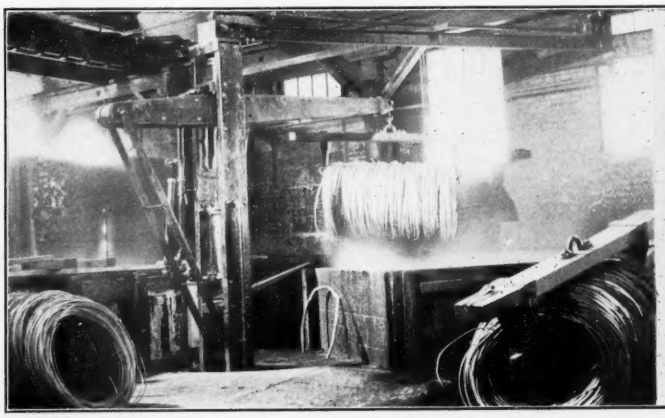


Fig. No. 11—General View of Rod Cleaning Unit.

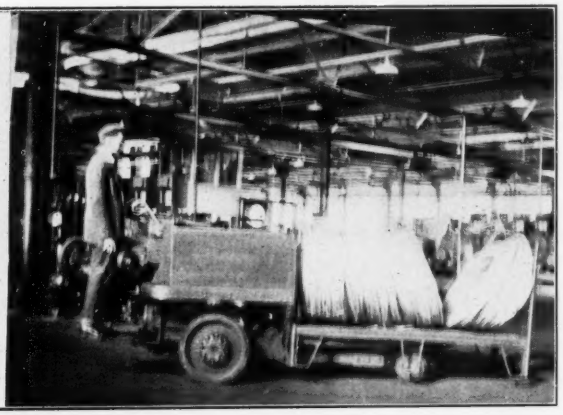


Fig. No. 12—Electric Truck and Skid of Rods.

tanks, washing tanks, grasshopper cranes, an electroplating unit, rod pointer and scarfing saw. The black oxide is removed from the rod by immersion of the rod in a solution of 3 to 5% sulphuric acid and water. The rods are placed on special bronze rods or sticks in one ton lots, handled by the grasshopper cranes and placed in the lead lined wooden tanks for about 30 minutes. The pickling solution is maintained at a temperature of 130°F. by means of a steam jet and with a maximum copper content of 8%. The best cleaning condition is with the 3 to 5% acid content at 130°F. but this may be increased to 10% acid at about 160°F. with equal results.

✦ ✦ ✦

AFTER the rods are removed from the pickling solution they are thoroughly washed by the impingment of a stream of water at 180 lbs. per sq. in. pressure directed at the coils, as they are suspended from the crane hook, to completely remove loose oxide scale and acid and are then immersed in a hot water alkaline solution to neutralize any remaining acid and provide a protection against further oxidation until the rods are drawn into wire.

✦ ✦ ✦

IN connection with the operation of the cleaning tanks the copper content of the solution is controlled by the intermittent operation of an electroplating outfit. The cleaning solution is pumped to the top tank of a series of tanks arranged in cascade, the solution returning to the cleaning tanks by gravity. These tanks are equipt with sheet lead anodes and copper plate cathodes and operate at 6 volts in series from a 2,000 ampere hour motor generator set. The copper is plated from the circulated solution to the copper sheets and the copper content of the solution kept uniform by periodical analyses and the intermittent operation of the generator.

✦ ✦ ✦

AT the completion of the rod washing and coating the rods are placed on skids ready for removal to the wire drawing departments by electric tractor (Fig. No. 12). While on these skids the rods are either pointed in preparation for threading the dies or scarfed on each end at an angle of 26° in preparation for brazing at the machines when it is desirable to draw the wire in longer lengths than the nominal 200-250 or 300 lb. coils.

Wire Drawing

THE wire drawing departments are divided in three subdivisions by the natural classification of equipment used in the operation.

Coarse—
(Sizes No. 4 B & S and Coarser)
Intermediate—
(Sizes No. 5 B & S to No. 20 B & S)
Fine—
(Sizes No. 21 and Finer)

SIZES No. 4 B & S and coarser are drawn on single hole blocks because of the very few holes required to finish a wire size from the rod, the frequency of the coils running out due to the short lengths drawn and the low fixed charges on this unit of equipment which is a very important factor in the cost of production.

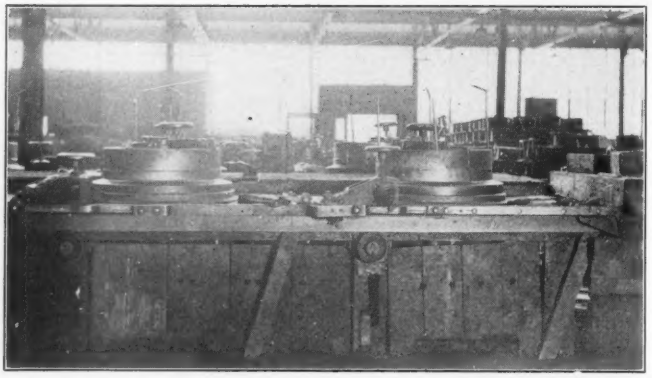


Fig. No. 13—Section of Block Bench. ✦ ✦ ✦ ✦ ✦

The blocks are arranged in benches of eight blocks each which are driven from a motor through a horizontal shaft and bevel gears to vertical spindles on which the blocks are mounted. (Fig. No. 13).

There is nothing in particular novel about this installation as it represents the first principles of wire drawing which every one knows.

✦ ✦ ✦

SIZES No. 5 B & S to No. 12 B & S are drawn on continuous machines of Waterbury Farrell Fdy. & Machine Co., manufacture. These machines are five, seven and eight die and finish at 1,000, 1,450 and 1,800 ft. per minute respectively. The draft on these machines is varied with the number of dies required to finish the range of sizes suitable for each machine dependent on the starting rod size.

THE maximum reduction possible in drawing copper in a single draft is slightly better than 50% in a soft rod, and 35% in successive drafts can be made without serious trouble but as these machines are designed and built with an increase in speed of 30% between drawing heads the

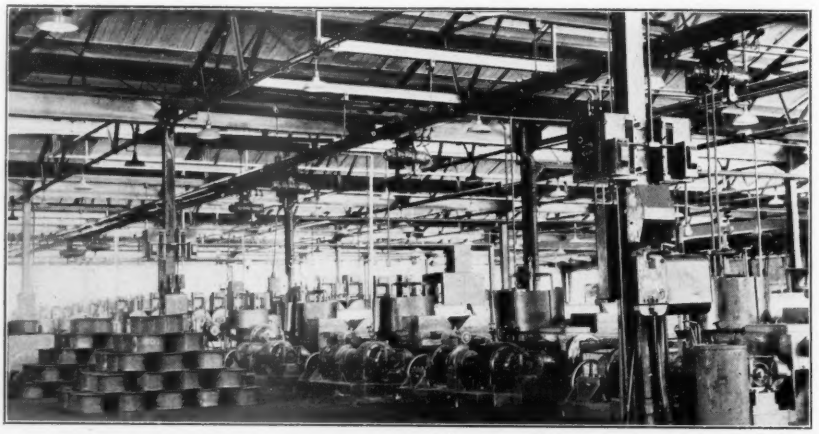


Fig. No. 14—General View of Wire Mill Showing Waterbury Machines. ✦ ✦ ✦

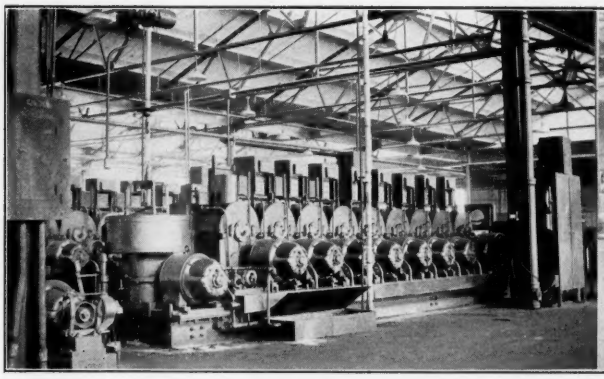


Fig. No. 15—General View 10 Draft A E W Continuous Machine Showing Drives.

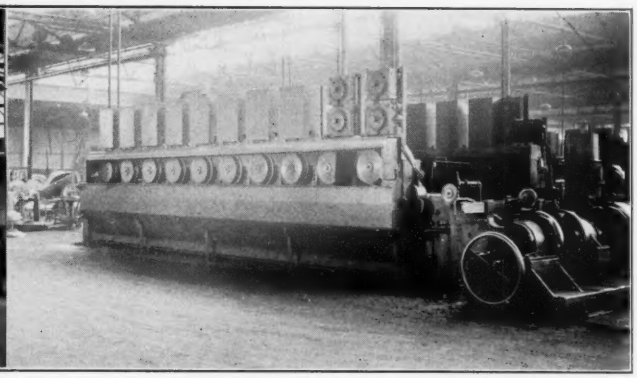


Fig. No. 16—Front View 10 Draft A E W Continuous Machine.

reductions are limited to 20.7% (normal Brown and Sharpe reduction) permitting approximately 5% slip, which is ample safety factor due to the nature of the stock being worked and the variations which naturally occur in die sizes while being worked.

✦ ✦ ✦

THESE machine units are as illustrated and have as auxilliary equipment a roll pointer, string up machine for threading the dies, brazing machine for brazing the rods together with silver solder so the wire can be run in longer lengths than the nominal bar lengths, take-up spooler and a stripping hoist.

These machines are driven with alternating current motors through a gear reduction unit to the main shaft of the machines and through hardened and ground spiral bevel gears to the horizontal drawing roll shafts. The gear housings are totally inclosed and the gears are lubricated by a circulating oil system.

The machines are built with a complete solution system integral but in this battery of machines a central system is employed with the advantage that one controlled solution is used on all machines, eliminating any temperamental idea which some wire drawers are apt to have regarding solutions, and the added cooling effect given to the compound by circulation.

✦ ✦ ✦

THE overall average production for these machines operated with one operator per machine is as follows:—

No. 5 B & S	**1,780 Lbs. per Hr.**
No. 6 B & S	**1,980 Lbs. per Hr.**
No. 7 B & S	**1,650 Lbs. per Hr.**
No. 8 B & S	**1,700 Lbs. per Hr.**
No. 9 B & S	**1,450 Lbs. per Hr.**
No. 10 B & S	**1,280 Lbs. per Hr.**
No. 11 B & S	**1,200 Lbs. per Hr.**
No. 12 B & S	**1,100 Lbs. per Hr.**

There production figures are long averages and represent total efficiency of machine, auxiliary equipment and operator.

✦ ✦ ✦

SIZES No. 12 to No. 15 B & S are drawn on machines which were developed and built at the American Electrical Works. These units consist of a ten draft continuous machine, roll pointer, string-up machine, brazer, spooler and stripping hoist.

The drawing rolls of these machines are individually motor driven and finish at a speed of 2,800 Ft. per minute. The wire is reduced from a rod through the Brown & Sharpe reduction.

These machines have their own solution systems, the compound being pumped directly to the dies only and as these machines operate with no slip between the drawing rolls and wire there is very little heating up of the wire and compound is used in very small quantities. The solution attains a temperature of about 110°F. when the machine is worked to capacity.

✦ ✦ ✦

SIZES No. 16 to No. 20 B & S are finished on machines similar to the machine described above the only exception being in the process size of wire used, this being drawn on the Waterbury Machines in sizes No. 6 for No. 16 or No. 10 for No. 20, the straight Brown & Sharpe draft being used throughout.

✦ ✦ ✦

Wire Drawing Solution

THE compound plays a very important part in the successful

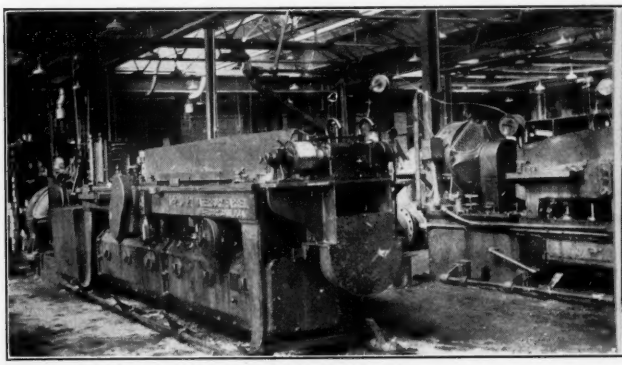


Fig. No. 17—Waterbury Farrel 12 Die Upright Roll Machine.

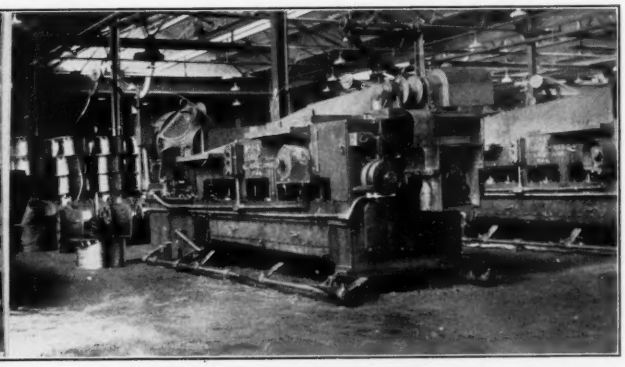


Fig. No. 18—Waterbury Farrel 16 Die Fine Wire Machine.

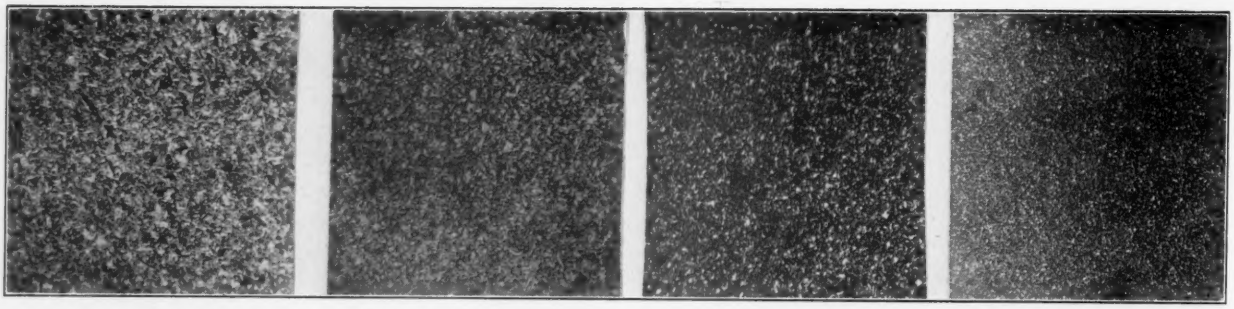


Fig. No. 19—2/0 Hard Drawn Copper. Magnified 100 X. ✦ ✦

Fig. No. 20—No. 2 Hard Drawn Copper. Magnified 100 X. ✦

Fig. No. 21—No. 8 Hard Drawn Copper. Magnified 100 X. ✦

Fig. No. 22—No. 14 Hard Drawn Copper. Magnified 100 X. ✦

operation of wire drawing machines at high speed. The compound usually consists of an emulsion of soap, tallow and water and in using commercial grades it has been determined that if the fat content is maintained at 3 to 4% satisfactory results may be expected. Very good results have also been obtained by the use of a mixture of 2 Vegetable Oil 1 Soap and 75 Water.

✦ ✦ ✦

Dies

TUNGSTEN Carbide dies are used entirely on all coarse and intermediate sizes of wire in sizes .057 and coarser but present a problem as to expected life in combination with the wire drawing solutions.

At present dies are being finished with bearing lengths of one half the diameter of the hole, with a 16° included angle in the reduction area and a 45° angle in the approach, the defined corners being rounded off when polished.

These dies are cut on semi automatic machines where the angles are set, the cut being made with an abrasive charged drill at about 60,000 R. P. M.

These dies are started at 1% undersize and are taken out when 1% oversize and our experience has produced the following productions. I have been lead to believe that values are low and therefore would welcome any comparisons or suggestions as to improved life.

B & S Decimal Life

Size	Size	
	.250	140,000 Lbs.
4	.204	120,000 "
5	.182	108,000 "
6	.162	100,000 "
7	.144	92,000 "
8	.128	84,000 "
9	.114	78,000 "
10	.021	56,000 "
11	.091	37,000 "
12	.081	19,000 "
13	.072	14,000 "
14	.064	10,000 "
15	.057	6,000 "
Total		831,000 Lbs per Die.

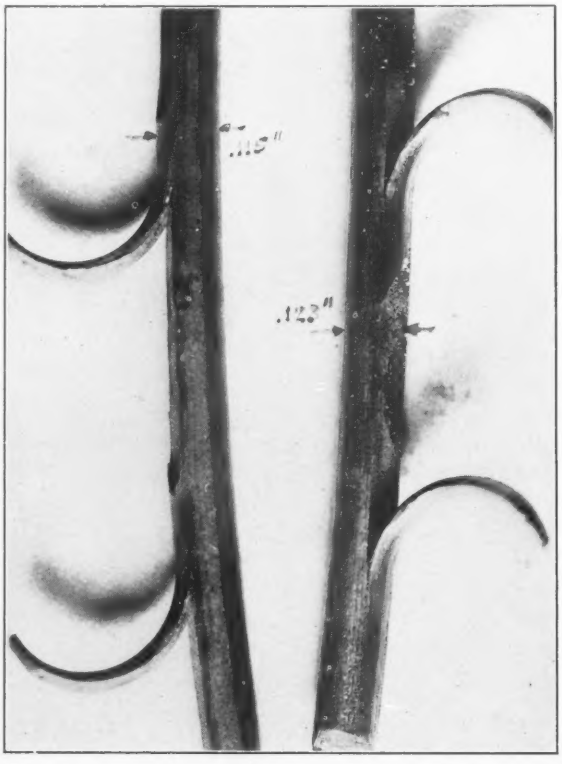


Fig. No. 23. ✦ ✦ ✦ ✦ ✦ ✦

THE advantages gained by the use of tungsten carbide dies over chilled iron dies are greater production per machine unit, greater efficiency from labor, more uniform gauge, ability to draw at higher speeds and decreased cost of die maintenance and replacements.

✦ ✦ ✦

Fine Wire Drawing

SIZES No. 28 and finer are drawn on Waterbury Farrel twelve die upright roll machines at a finishing speed of 2,500 Ft. per minute. The process wire is taken from the larger machines at a size to finish the required size in twelve reductions. Diamond dies are used entirely in combination with a solution of white soap and water.

✦ ✦ ✦

SIZES No. 28 and finer are drawn on No. 1A Waterbury 16 die machine at a finishing speed of 3,000 to 3,500 Ft. per minute. The process size is varied as in the twelve die machines dependent on the size to be finished. As the greatest production from this unit is in size No. 30 B&S, No. 14 B&S is used as a process size this being drawn on the A. E. W. 10 die continuous machines.

Diamond dies and white soap solution are used on these machines and the intermediate reductions follow the Brown & Sharpe gauge.

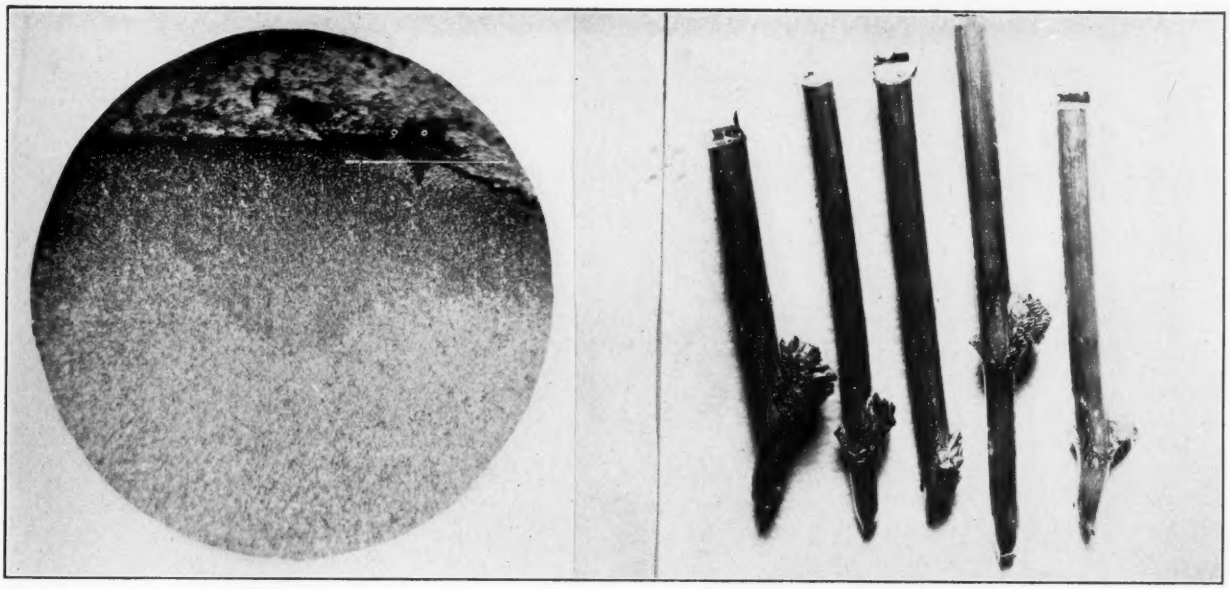


Fig. No. 24. ✦ ✦ ✦ ✦ ✦ ✦ ✦ Fig. No. 25—Effect of Plugged Dies. ✦ ✦ ✦ ✦

AS any drawing operation tends to harden copper the more working the metal gets the finer its crystal structure. By referring back to the photo micrographs showing the structure of the cast bar and finished rod you will see the crystal size with which we start and below for purposes of comparison photo micrographs are shown at various stages of drawing.

✦ ✦ ✦

AS an illustration of a few of the defects which can develop during drawing the spikes on the wire (Fig. No. 23) will show what can be caused by improperly reamed dies or by improper drafting. You will note from the dimensions which were observed at 90° the effect of the unequal stresses also from the parrallel photo micrograph the uneven crystal structure (Fig. No. 24) indicating that the surface of the wire has been worked harder and elongated more than the central portion.

✦ ✦ ✦

PLUGGED dies causing breaks as shown by the five specimens (Fig. No. 25) can be caused by seams in the wire, slivers, scales or by the dies cutting out. The combination of the oils or tallow with this collection piles up in the back of the die until the tension required to pull the wire through is greater than the strength of the wire with the resultant break.

✦ ✦ ✦

Annealing

ANNEALING is the art of heat treating to relieve the strains set up in the metal due to working, increasing the elongation and size of crystal in the metallic structure. The operation is divided into two classes by nature of the equipment employed, coarse and fine.

✦ ✦ ✦

THE coarse wire annealing is performed in an automatically controlled oil fired car type furnace of Kenworthy manufacture.

This furnace is constructed with two elevator rams working in the well of the furnace on which are mounted the loading platforms. The well is filled with water providing a seal for the retort and the car which houses the retort is traversed over the loaded platforms when they are in their down position, registering over the load of wire with the center of the retort. The work is raised by the elevators into the retort where it remains for the annealing period.

These furnaces are operated at a temperature of 1200°F. at the pyromometer tip which is located on the inner side of the retort about 18″ from the top. The burners being automatically controlled by a potentiometer control and recorder.

When the charge of wire, about 10,000 lbs., is put in the retort the temperature drops about 150°F. which is regained in about forty five minutes. The usual annealing time for this quantity of wire is one hour and twenty minutes.

The wire is usually graded before packing on the loading platform, the coarser wire is placed on the top of the heat because of the slightly higher temperature obtained at this point, and the assur-

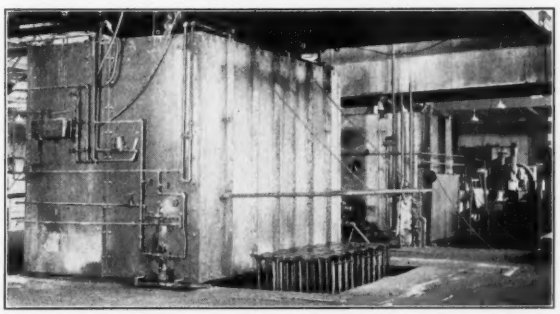
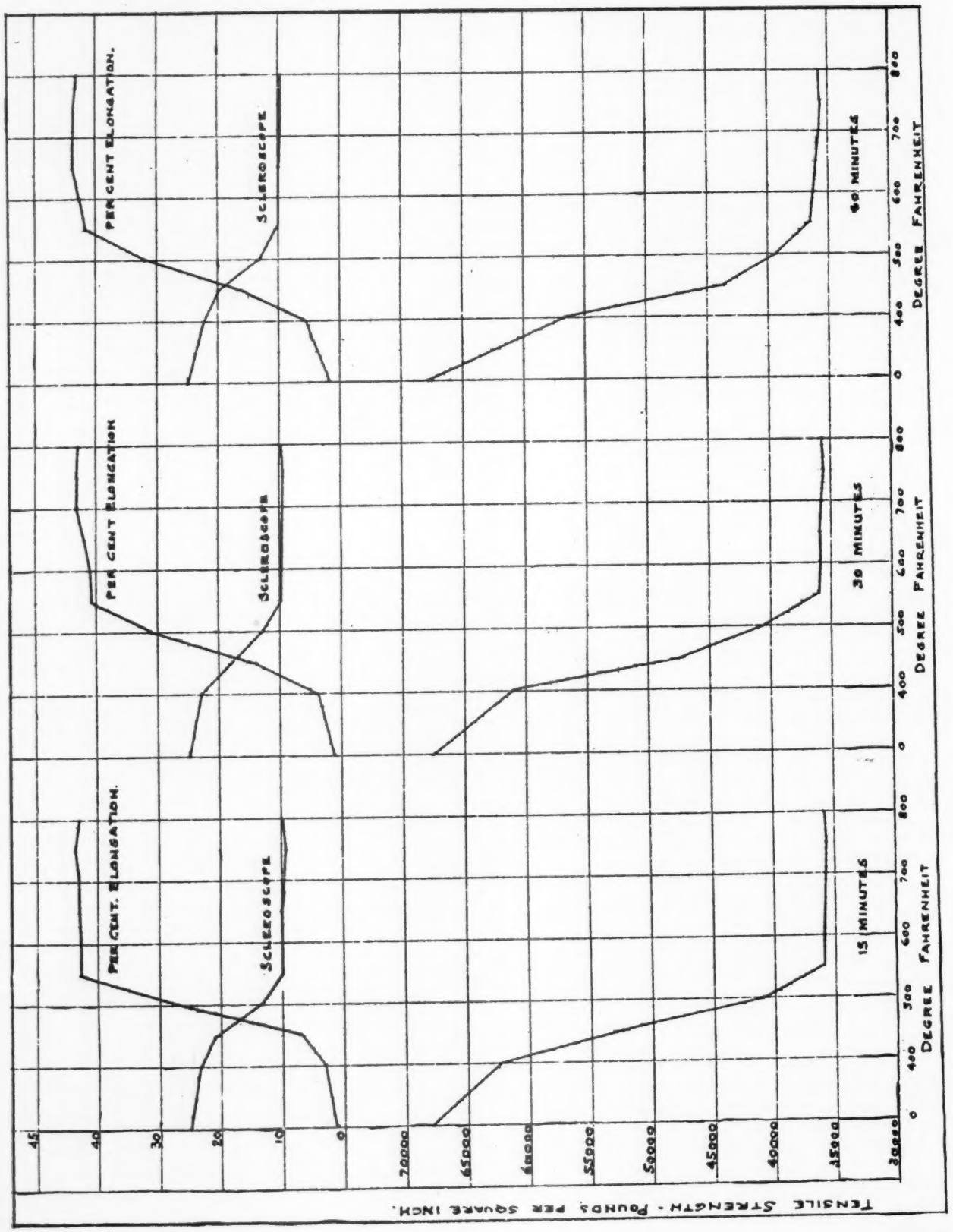


Fig. No. 26—Kenworthy Car Type Annealing Furnace. ✦ ✦

Fig. No. 28.


TENSILE STRENGTH - POUNDS PER SQUARE INCH.
PER CENT. ELONGATION.
SCLEROSCOPE
PER CENT ELONGATION
SCLEROSCOPE
PER CENT ELONGATION.
SCLEROSCOPE
15 MINUTES
30 MINUTES
60 MINUTES
DEGREE FAHRENHEIT
DEGREE FAHRENHEIT
DEGREE FAHRENHEIT

ance of complete annealing while the finer wires are placed at the bottom of the load to prevent sticking caused by excessive heat.

✦ ✦ ✦

ALTHOUGH this in a non oxidizing furnace certain added precautions are necessary to insure bright wire. After the load of wire is lowered into the well sufficient time should elapse to permit the escape of all air trapped in the coils or reels. Dry steam is injected into the retort so that there is a slight pressure at the vent at all times thereby preventing the intake of air during the annealing cycle. When the charge is lowered into the cooling water the temperature of the water will rise rapidly. Cold water is flooded into the well dissipating the heat stored in the work, which is left in the well cooling until it has reached a temperature of about 110°F. when the work is considered cool enough to handle and well below an oxidizing temperature when exposed to the atmosphere.

At certain humid seasons of the year it has been found advantageous to add to the water a small amount of tallow solution on the theory that the wire gets a very thin protective coating. The results obtained justify the theory.

As a further precaution against oxidization of discoloration after annealing all the finer sizes of wire in coils and all wire annealed on iron reels is treated in a vacuum oven, which removes all traces of water which would naturally be trapped between the strands and cause discoloration if permitted to lay around any length of time before being used.

✦ ✦ ✦

FINE wire is annealed in an electrically heated furnace, the retort being heated by an upper and lower set of heating units. The lower row of heaters is on constantly and is operated by hand switches as variations in the annealing heats may be demanded, the upper tier being on automatic control.

This unit is arranged in a circle, the annealing pots being mounted on trucks with a water seal integral. The wire is loaded on the trucks and a cover lowered over

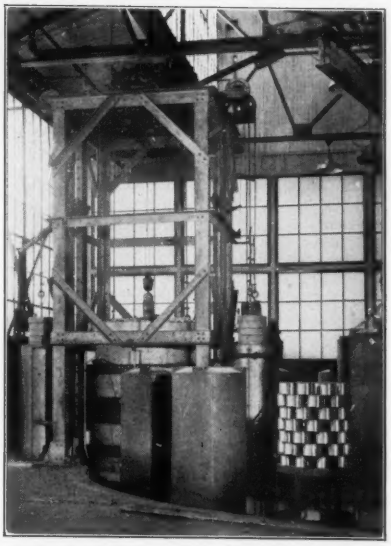


Fig. No. 27—A E W Fine Wire Annealing Furnace.

✦ ✦ ✦ ✦ ✦

the wire and into the water seal by a jib crane and hoist which swings on the same radius as the center of the gauge of the rails on which the trucks are mounted.

Air is excluded from the pots by the injection of gas into the chamber prior to entering the retort.

(*Please turn to page 363*)

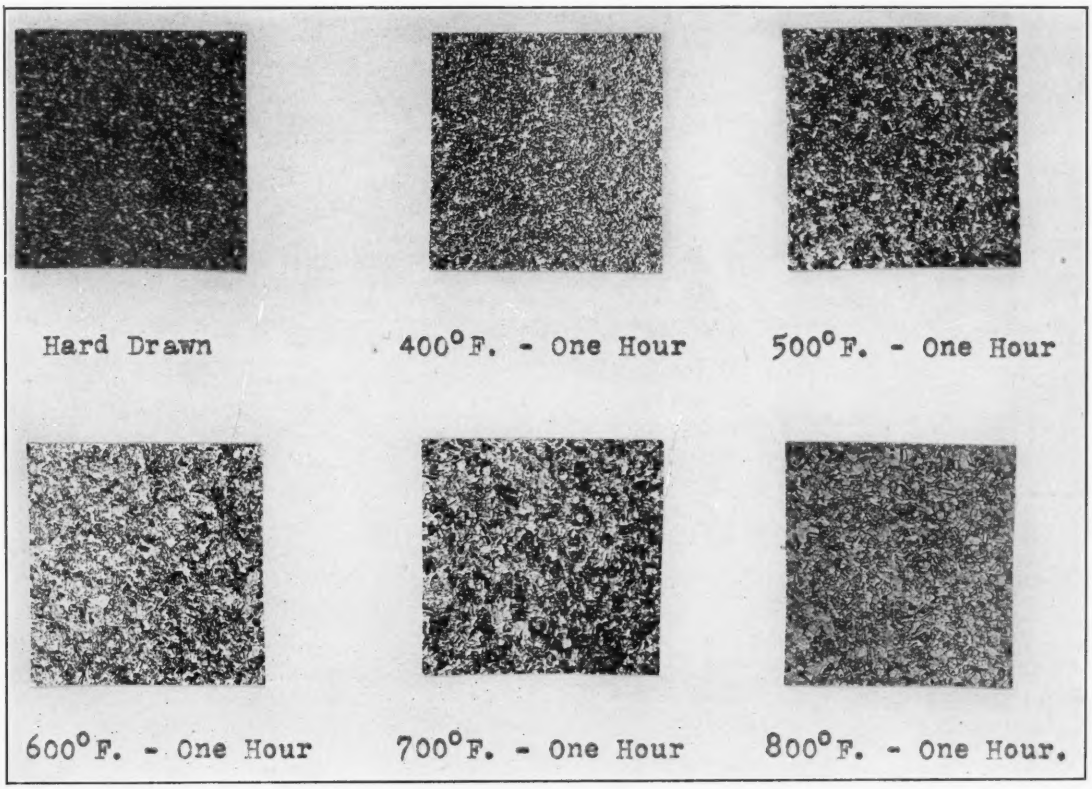


Fig. No. 29—Sections of Annealed Wire at Varying Temperatures. Magnified 100 X.

✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦

Patenting of Rods and Wire

By R. B. Whyte

General Supt., The MacWhite Company, Kenosha, Wis.

In Order to Get Uniform Patenting, the Control of Temperatures Must Be Accurate and Uniform.

A Description of Different Sorbite Structures Resulting From Changes in Heat Treatment.

WHAT is patenting? It is the heat treating of a carbon steel to produce a sorbite structure. In order to produce a sorbite structure the steel must be heated well above the critical temperature and then cooled at a definite speed.

✦ ✦ ✦

THERE are many different types of furnaces in patenting. All will do patenting if they are operated to produce a sorbite structure. There are many different types of fuels used. All fuels are suitable provided they do not create, around the steel being patented, an oxidizing atmosphere causing excessive surface decarburization. Slight surface decarburization is not objectionable, for this seems to aid diffusion.

✦ ✦ ✦

IN order to get uniform patenting, the control of temperatures must be accurate and uniform. The speed at which the material is drawn through the furnace must be uniform and constant. Equipment for regulating this speed must be capable of giving any speed between the low and high of the range required.

✦ ✦ ✦

THE object of patenting is to produce sorbite structure in the steel. Sorbite is a structure that in cold drawing has freedom to yield to deformation in any direction. It is the structure that will submit to the greatest amount of cold drawing and at the same time retain maximum toughness.

PHOTOMICROGRAPH (Fig. 1) illustrates the typical fibrous structure of a cold drawn wire of 0.75% carbon content. The ultimate tensile strength of this material is 265,000-275,000 lbs. per sq. in. and the torsions on 100 diameters average 40. This wire received approximately 80% reduction in cross-sectional area in being drawn 5 holes from the patented state.

✦ ✦ ✦

OTHER structures can be obtained by running wire through a patenting furnace and if great care is not taken they often are obtained. Lamellar pearlite is one of these structures and is obtained either by not heating to a high enough temperature or cooling too slowly.

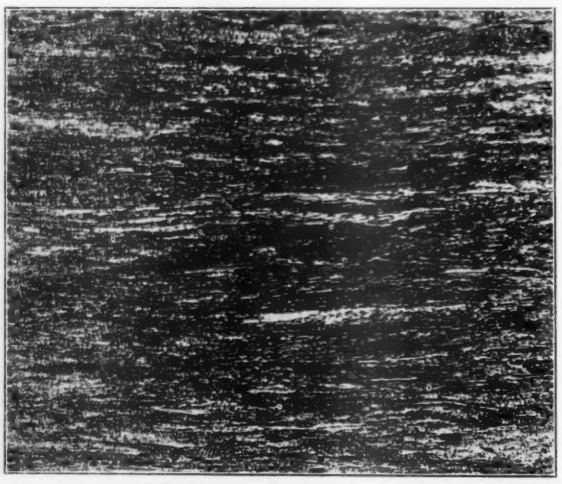


Fig. 1—Magnifications—200.

✦ ✦ ✦

0.50% Carbon Material

FIGURE 2 and Figure 4 are good examples of structures obtained by subjecting metals of the same constitution to different cooling rates.

✦ ✦ ✦

IN figure 2 the metal cooled more slowly; the structure consists of lamellar pearlite, sorbitic pearlite, some sorbite and considerable free ferrite at the grain boundaries and within the grains. In figure 4, sorbite and sorbitic pearlite are the predominant constituents—a minimum of free ferrite is present, the more rapid cooling preventing its precipitation and retaining it in solid dispersion with the pearlitic constituents. Figure 4 is a very desirable patented structure.

✦ ✦ ✦

PHOTOMICROGRAPHS Fig. 2 and Fig. 3 illustrate the grain structure of a longitudinal section of 0.50% carbon steel, patented at 1700° F. (927° C.) and air-quenched. The physical properties of this material in the patented state follow:

Ultimate Tensile Stress —110,000 to 120,000 lbs. per sq. in.

% Elongation on 10"—10%-15%.

% Reduction in Area at Fracture—45%-55%.

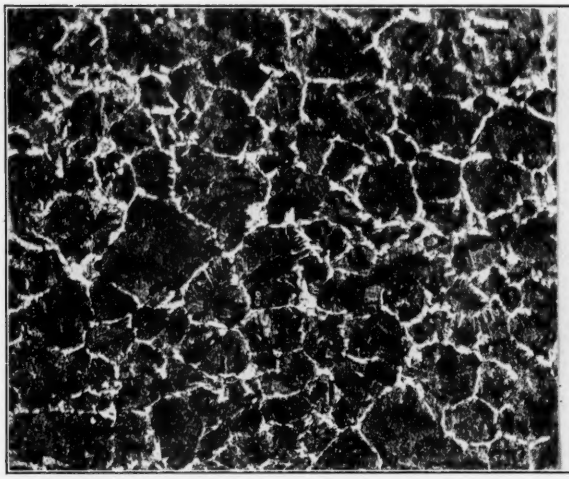


Fig. 2—Magnifications—200.

Fig. 3—Magnifications—1500.

PHOTOMICROGRAPHS Fig. 4 and Fig. 5 illustrate the grain structure of a longitudinal section of 0.50% carbon steel, patented at 1832° F. (1000° C.) and quenched in molten salt maintained at a temperature 890° F. (477° C.) The physical properties of this material follow:

Ultimate Tensile Stress—125,000-135,000 lbs. per sq. in.

% Elongation on 10″—7%-12%

% Reduction in Area at Fracture—45%-55%.

THIS structure, while lending itself readily to cold drawing, does not make a tough wire because it does not have that freedom to yield to deformation in any direction. Consequently, when that freedom to yield is not in the direction of the flow caused by cold drawing, the structure tends to separate causing minute cracks.

✦ ✦ ✦

PROPERLY patented wire has very definite physical properties. For a given carbon content wire the tensile strength will be between close limits. When the wire is fractured in the tensile test, the reduction in cross-sectional area at the fracture will be quite constant. When wire is drawn from steel having sorbite structure, the increase in tensile strength due to cold drawing is very constant. Therefore, the tensile strength of the finished wire can be pretty well determined by knowing what additional tensile strength a given per cent reduction in cross-sectional area will add to the tensile strength of the patented wire.

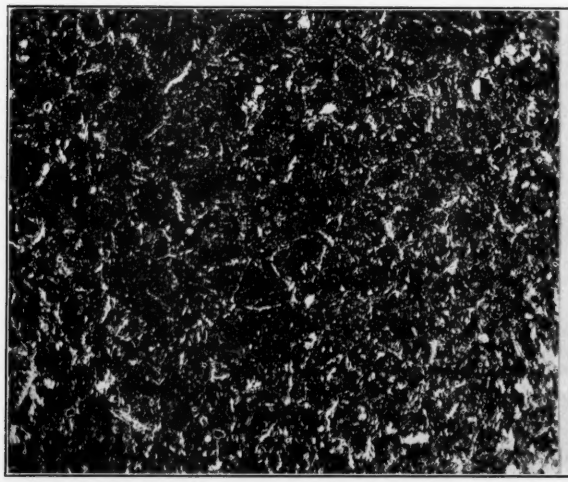


Fig. 4—Magnifications—200.

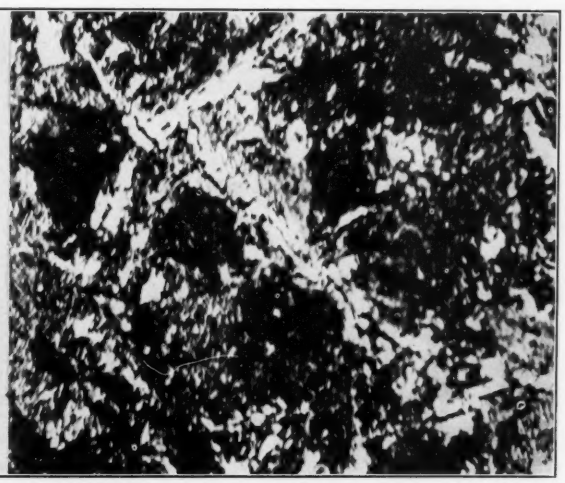


Fig. 5—Magnifications—1500.

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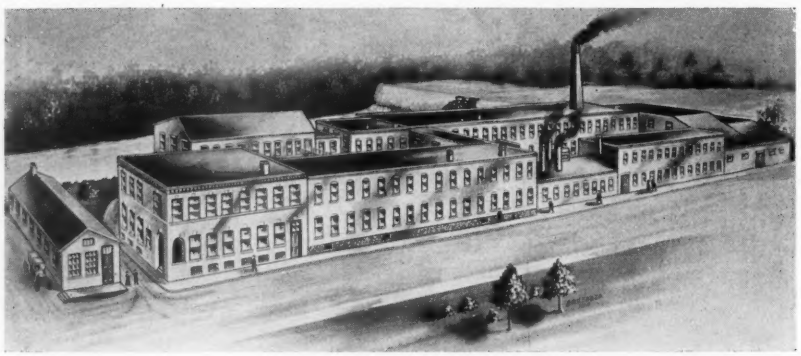

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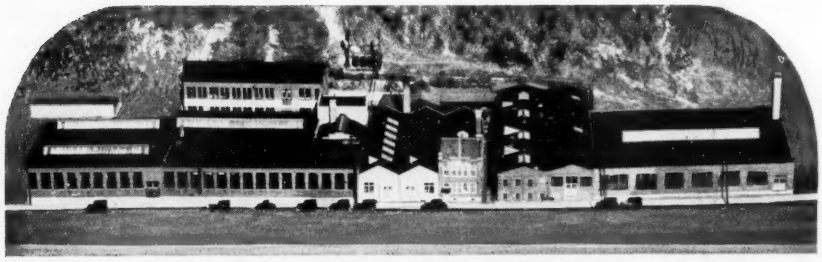

AERIAL VIEW OF PLANT OF HUDSON WIRE CO., OSSINING, N. Y. ▲ ▲ ▲
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"HUDCO" High Conductivity Electric Wire

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High Brass, Low Brass, Zinc 99.99+ and High Tensile Zinc, Commercial Bronze Phosphor Bronze, Pure Tin, Lead, Antimonial Lead, Cadmium, 10%, 18% and 30% Nickel Silver, Silver Plated Copper, False Gold and Special Brass and Bronze Alloys to Specification.

BRUSH WIRES, CRIMP and STRAIGHT

Brass, Steel, Nickel Silver, Copper and Phosphor Bronze

TINSEL LAHNS

Silver Plated Copper, False Gold and Copper

METALLIC FIBRE FOR PACKING PURPOSES

Copper, Bronze, Zinc, Lead and Aluminum

WIRES FOR METAL SPRAYING

Zinc, Tin, Lead, Cadmium, Copper, Bronzes, Nickel Silver, Aluminum and other wires to specification.

ROLLED FLAT WIRE WITH ROUND EDGES

Copper, Brass, Nickel Silver, Zinc, Lead, Phosphor Bronze and other wires to specification.

"Hudco" copper wire is drawn by the Hudson Wire Company of Ossining, N. Y., who have been specialists in the manufacture of fine wires for over thirty years. ▲

The best grade of copper drawing stock is used, insuring the maximum conductivity. ▲ ▲ ▲

A new process of drawing and annealing is used which produces a wire unusually smooth, clean and uniform in color for enameling and other purposes. ▲ ▲ ▲

Painstaking care in the selection and maintenance of dies guarantees a product accurate to gauge and resistance. ▲ ▲ ▲

You can rely on "Hudco" wire always. ▲ ▲ ▲

Expert annealing of the wire prevents unnecessary breakage when winding the wire into coils. ▲ ▲ ▲

If you, too, have a specific problem demanding wire of exact requirements, write to us about it. ▲ ▲ ▲

It costs nothing and involves you in nothing. ▲ ▲ ▲

Better wire at lower cost. ▲ ▲ ▲

We can serve you quickly and economically.
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HUDSON WIRE COMPANY

Ossining, N. Y.

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"HUDCO"
FINE WIRES

PATENTING can be done at a wide range of temperatures above the critical temperature. The reason for this is that patenting is a temperature-time process. If the temperature is high the time can be low and if the temperature is low the time must be high.

✦ ✦ ✦

SO far we have not considered the cooling in the patenting operation. The control of the rate of cooling is really that part of the patenting operation that determines the structure, namely sorbite.

✦ ✦ ✦

WHAT is sorbite? The Metallurgist will perhaps answer—"sorbite can be considered that constituent of steel which exists as one in cooling steel from a temperature above the critical to atmospheric and is characterized by a uniform dispersion of the particles of ferrite and cementite which constitute the steel."

✦ ✦ ✦

PHOTOMICROGRAPHS Fig. 6 and Fig. 7 illustrate the grain structure of a longitudinal section of 0.75% carbon steel, patented at 1850° F. (1010° C.) and quenched in molten salt maintained at 890° F. (477° C.) The physical properties of this material follow:

Ultimate Tensile Stress—150,000-160,000 lbs. per sq. in.

% Elongation on 10"—7%-10%

% Reduction in Area of Fracture—25%-35%.

NOW that we know just what sorbite is, how are we going to get it? In the first place we must get that dispersion of particles of ferrite and cementite by heating the steel well above the critical temperature because the higher the heat within practical limits, the more complete the dispersion. The period of time to keep the steel at this temperature depends upon the amount of grain growth desired.

✦ ✦ ✦

WE still have a job on our hands. The uniform dispersion of particles of ferrite and cementite is now complete but the steel is at a temperature at which they are in solid solution. The job is to keep this uniform dispersion when the steel has cooled to atmospheric temperature. This can be done by controlling the rate of change in temperature of the steel in passing through the critical range. This operation must be definite and constantly uniform. Therefore, the steel in passing from the high temperature of the furnace must be submerged in a quenching medium, the temperature of which is kept constantly uniform at a definitely controlled point.

✦ ✦ ✦

THE usual quenching medium is lead or salt. Lead dissipates heat rapidly by conduction; salt by convection. Advocates of salt claim that it is more desirable because the dissipation of heat by convection adjusts itself readily to changes in mass. In other words, when a larger size wire is quenched in salt the dissipation of heat is increased by convection and the rate of change through the critical range is kept uniform.

✦ ✦ ✦

IN checking the structure of patented wire, it is absolutely necessary to use high magnification. At low magnification the structure may give the appearance of sorbite which is only partially present.

✦ ✦ ✦

IT is also very advisable to always use the same magnification in checking for sorbite.

✦ ✦ ✦

PATENTING is a temperature-time operation and must be kept uniform. Any slight change in temperature or time produces slight differences in the resultant structure. Uniformity, therefore, is all important.

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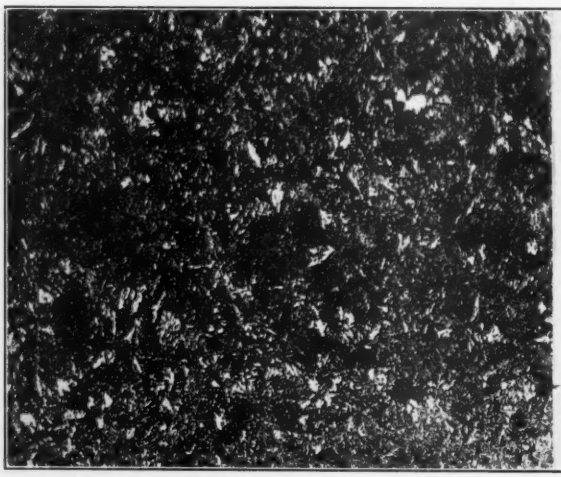

Fig. 6—Magnifications—200.

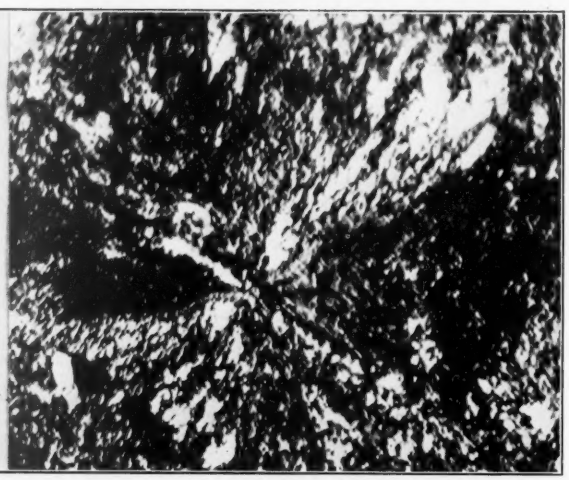

Fig. 7—Magnifications—1500.

Wire Mill Cost Records

By R. F. Cohn
Factory Manager, Reynolds Wire Co., Dixon, Ill.

A description of a simple cost system that can be applied to wire mill work and a graphical method of daily records of cost, quality or quantity.

THE purpose of a wire mill is to make money. The management of a wire mill is faced with maintaining a favorable margin between costs and selling prices. To accomplish this, the cost of each product and of each step in the processing of each product must be known in detail. Purchase of new equipment, extension of sales effort and remuneration of personnel must depend upon estimates based upon such cost records.

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THE object of this paper is to suggest to the members of the Wire Association a simple cost system that can be applied to wire mill work and a graphical method that gives a daily record of cost, quality or quantity. These methods are not entirely new, but their simplicity and usefulness should appeal to wire mill men who realize that their present partial records are not quite all that is desired.

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A complete record of operations should consist of cost figures, quality figures, comparisons shown by graphs and explanations of anything unusual connected with the operation during the period covered by the report. Records used for making comparisons are of much greater value if they contain notes of important changes in materials, processing or accounting.

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Cost Records

TO serve as an example, let us consider what would be required to make a control record of the production of 20 ga. liquor-finished (copper coated) steel wire. We shall assume that the wire has been drawn from No. 5 rod to No. 13 ga., annealed in pots at 13 ga., pickled, drawn to 19 ga., bright annealed, copper coated and drawn to finished 20 ga. wire. The cost figures will be used as illustrations only, and will bear little relation to usual actual costs. A setup as shown in Table 1 is suggested.

TO determine the detailed items of cost of each operation a series of account numbers is used. Table No. 2 shows an abbreviated list of account numbers for the Cleaning Department. The first digit from the left shows the department number, the second digit indicates classification into labor, supplies, etc., and the third digit specifies the particular item. For instance, Account No. 143 is a Cleaning Dept. (No. 1) number referring to supplies, (4) the particular item (3) being shown by the key sheet to be lime.

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LET us study the use of "variation factors" for the Cleaning

Table No. 1

Cost per ton of making 20 ga. Coppered Wire:	Dept. Average Cost	Variation Factor	Cost per Ton
Rods			$38.20
Metal Loss on rods 1%			.38
Dept. 1 Cleaning & Baking	$2.40	0.80	1.92
Dept. 2 Rod Bench No. 5 to No. 13	6.00	1.10	6.60
Dept. 3 Annealing 13 ga.	4.00	1.00	4.00
Dept. 1 Cleaning & Baking 13 ga.	2.40	1.00	2.40
Metal loss cleaning 13 ga. 1%			.51
Dept. 6 Intermediate Machines	15.00	0.90	13.50
Dept. 8 Bright annealing	6.00	1.00	6.00
Dept. 9 Copper coating	6.80	0.90	6.12
Dept. 14 Wet drawing	10.00	0.90	9.00
Dept. 20 Shipping	1.00	1.00	1.00
Total Manufacturing Cost per ton			$79.63

THE variation factor is required where several different sizes or types of wire are handled by a department. For instance, the Cleaning Department pickles both rods and annealed wire. It obviously costs less to clean a ton of rods than a ton of 13 ga. wire. The average cost multiplied by the "variation factor" for that gauge gives the cost of a particular gauge. The method of obtaining these factors will be shown later. House. These factors convert the average cost for the month into the cost of processing a particular gauge during the month. If only rods are cleaned, the actual cost is the average cost. If rods and 13 ga. wire are cleaned, the rods will cost less than the average, and the wire more than the average due to greater labor, acid lime, etc. A simple use of the factors is shown in Table 3.

Table No. 2

Cleaning & Coating Dept.
Dept. No. 1

	Total Cost	Cost per Ton	Quantity per ton
DIRECT LABOR:			
111			
INDIRECT LABOR:			
121 Stocking Wire			
122 Learners			
123 Unloading Acid			
124 Unloading rods			
MAINTENANCE:			
131 Cranes & motors			
132 Acid tubs			
137 Baker			
SUPPLIES:			
141 Acid			
142 Inhibitor			
143 Lime			
144 Fuel for baker			
FIXED CHARGES:			
151 General fixed charges			
152 Supervision			
CURRENT OVERHEAD:			
161 Scrap wire			
162 Purchased power			
163 General Overhead			
TOTAL COST FOR PERIOD			

Table No. 3

PRODUCTION: Rods, 100 tons, and 13 ga. wire, 50 tons.
Total 150 tons.
Total department cost for month—$90.00
Average department cost for month—.60 per ton
Variation factor for rods, previously determined on annual basis as 0.90 and 13 ga. as 1.20
Cost of cleaning rods: $.60 x 0.90—$.54 per ton
Cost of cleaning wire: $.60 x 1.20—$.72 per ton
To check: 100 tons of rods @ $.54—$54.00
50 tons of 13 ga. @ $.72—$36.00

Total department cost	**$90.00**

A slightly more complicated case is shown in Table 4.

Table No. 4

PRODUCTION: Rods, 100 tons, 12 ga. wire 25 tons, 15 ga. 25 tons.
Total department cost for month—$90.00
Average department cost for month— 0.60
Variation factors, previously determined:
Rods, 0.90; 12 ga. 1.15; 15 ga. 1.25
Cost of cleaning rods $.60 x .90—$.54 per ton
Cost of cleaning 12 ga. $.60 x 1.15 $.69 per ton
Cost of cleaning 15 ga. $.60 x 1.25 $.75 per ton
To check: Rods 100 tons @ $.54—$54.00
12 ga. 25 tons @ $.69— 17.25
15 ga. 25 tons @ $.75— 18.75

Total actual cost	**$90.00**

VARIATION factors need be changed only when the nature of the process is changed or when the proportions of the various sizes get badly out of the ordinary. They should be checked once a year. In any one month, there will be some discrepancy between the actual total department cost and the cost resulting from adding together the various gauges. This is shown in Table No. 5.

How are these factors determined? Let us take the simple case of a department handling only two types of material and having a monthly cost sheet as shown in Table 6.

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IN annealing the gauges shown in Table 6 the same furnaces and temperatures are used but the time required varies. The 12 ga. is in the furnace 12 hours, the 13 ga. 10 hours, and the 15 ga. 9 hours. The labor required to load a heat is the same per ton regardless of gauge.

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THE total labor per ton is thus $0.25, and the other items vary with length of time in the furnace. The average cost per ton is $.25. The average time in the furnace is 10 hours. The cost of each gauge is arrived at as follows:

In the following month Dept. 3 may show an average cost of $.52 per ton of wire. The cost of 12 ga. in that month would be $.52 x 1.10 =$.572.

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ASSUMING that such a system has been in use for a number of months, the wire mill executive has detailed figures on which to pay bonuses, to determine weak spots in operations or upon which to base estimates of economies to be gained by a proposed change in equipment. For instance, he may set up an estimate of how much he would save were he to install an electric, bright annealing furnace in place of another oil-fired, pot furnace. His sheet would be started as shown on Table 7.

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LET me repeat that these figures have been chosen more or less at random, and are not intended to show the actual cost of electric annealing; but merely to demonstrate the method of making a comparison between methods of processing involving several departments.

Daily Control Graphs

THE above accounts are available monthly and show the average cost per ton of each item and total average of all items. For immediate control purposes a chart is desirable on which only important expenses are shown daily in relation to standard costs. The daily chart is ideally suited to the close control of cost, quality and rate of production. Such charts are built up upon the basis of tonnage, cost and standard average cost. Their construction and use is a subject too large for detailed discussion in this paper.

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Metal Balance

AN important item of cost is the shrinkage between rods and finished wire. An accurate metal balance is necessary to determine the extent and value of these losses. This involves the accurate weighing of rods and wire between departments, the reporting of scrap wire, nail shorts, etc., and a metal balance sheet covering a definite period of time, such as one fiscal year. Beginning inventories plus purchases of rods must balance with the ending inventory plus finished wire and scrap produced by the departments cleaning and drawing the rods. A shortage of 1% to 2% must be charged to operations as a "metal loss". There is an actual loss of above 1% of the rods during pickling and there is also a slight loss due to other factors. In each subsequent drawing or cleaning operation additional losses are incurred which show up when a balance is made between the weight of wire entering an operation and the finished wire. Such losses are indicated in item 7 of Table No. 1.

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THESE methods may appear bewildering at first glance, but their actual use is extremely simple. After such a system has been adopted for a few months or a year, reliable figures become available as a guide for intelligent management.

Table No. 5

PRODUCTION: Rods, 120 tons; 12 ga. wire 25 tons; 13 ga. wire 20 tons; 15 ga. wire 15 tons; Total 180 tons.

Total department cost $118.80 Average cost $0.66 per ton Variation factors as above.

	Average Dept. cost		Variation Factor		Cost per Ton
Rods	$.66	x	$.90	—	$0.594
12 Ga.	.66	x	1.15	—	.759
13 Ga.	.66	x	1.20	—	.792
15 Ga.	.66	x	1.25	—	.825

To check:

Rods	120 tons @	$.594—	$71.28
12 Ga.	25 tons @	.759—	18.98
13 Ga.	20 tons @	.792—	15.84
15 Ga.	15 tons @	.825—	12.37
Total cost by factors			$118.47
Total actual cost			118.80
Error—less than 1/3 of 1%			.33

Table No. 6

Abbreviated Cost Sheet, Dept. No. 3 (Annealing)

Account		Cost	Cost per ton
1	Direct Labor	$10.00	$.25
2	Indirect Labor	2.00	.05
3	Maintenance	1.00	.025
4	Supplies	4.00	.10
5	Direct O. H.	1.00	.025
6	Current O. H.	2.00	.05
	Total cost	$20.00	$.50

PRODUCTION:

12 Gauge	10 tons @ 12 hours	120 ton hours	
13 Gauge	10 tons @ 10 hours	100 ton hours	
15 Gauge	20 tons @ 9 hours	180 ton hours	
Total	40 tons	400 ton hours	

Average hours per ton—10 hours.

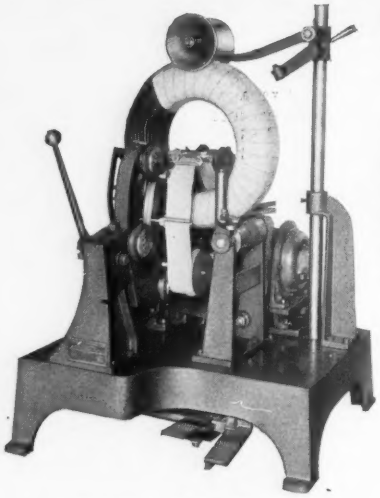
Table No. 6A

	12 Ga.	13 Ga.	15 Ga.
LABOR	$.25	$.25	$.25
OTHER ITEMS	.25 x 12/10=.30	.25 x 10/10=.25	.25 x 9/10=.225
TOTAL COST	.55	.50	.475
	.55	.50	.475
FACTOR	—=1.10	—=1.0	—=.95
	.50	.50	.50

Table No. 7

Estimated Cost of Bright Annealing

Account		Present Cost Per Ton	Estimated Cost Per Ton
311 etc.	Annealers—Direct Labor	$ .25	.25
321 etc.	Annealers Indirect Labor	.05	.10
331 etc.	Annealers Maintenance	.03	.01
341	Annealers Supplies (fuel Oil or Electricity)	.60	1.80
342	Annealers Supplies Pots	1.20	.20
343	Annealers Supplies Other supplies	.02	.12
351	Annealers Direct Overhead	1.00	2.00
361	Annealers Current Overhead	2.00	2.00
Dept. 1	Cleaning and coating 13 ga. wire	2.40	
	Coating for bright annealing		.50
	Metal Loss in cleaning 13 ga.	.60	
441	Die cost on Intermediate Mchs.	.50	.30
461	Wire scrap on Intermediate Mchs.	.20	.15
		$8.82	7.03



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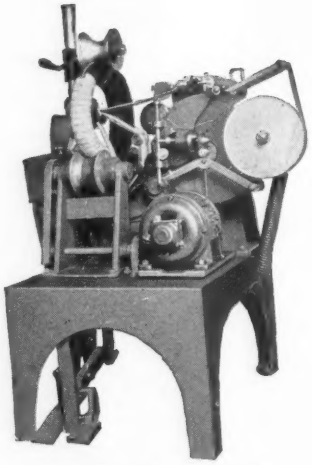

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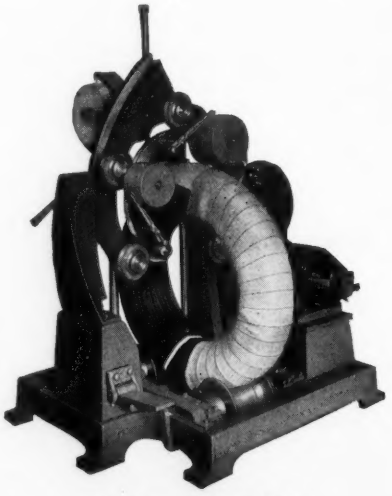

Model 4, Large Size Coils

TERKELSEN MACHINE COMPANY

3260 A Street, Boston, Mass.

Process Control in Manufacture of Rubber Covered Wire

By E. G. Sturdevant
United States Rubber Co., Bristol, R. I.

In Order That Operations May Be Carried Out Efficiently It Is Necessary to Maintain Control of All Changes Through Simple and Direct Methods.

This Paper Presents a Method Which Has Been Found to Accomplish the Desired Control. ▼ ▼ ▼ ▼ ▼

THE operating function of any manufacturing organization is the act of changing the status, that is the form, dimensions or composition of raw materials into a finished manufactured product according to a definitely set up procedure designed to produce the qualifications given in the specifications for the finished product. In the manufacture of rubber covered wire in particular this covers the drawing, annealing and tinning of wire, the assembly of the conductor, the production and application of the insulation and moisture and weatherproofing coverings. In order that these operations may be carried out as efficiently as possible it is necessary that the procedure set up for their execution be simple and direct. Such a procedure results from a detailed technical study, properly described as research, upon the operations involved, and the equipment and raw materials required. The simplified specific procedure or standard set up as a result of the detailed study of the various factors is a process specification and the control of the operating function according to such a specification is called process control. The purpose of process control is to insure the production of the manufactured goods in accordance with the anticipated, scientifically planned result, or in the case of failure to do so, to make possible the tracing of any serious variations in the quality of material in process or the finished product to their source so that their cause may be eliminated. The accomplishment of this requires that sufficiently detailed records be kept of the raw materials, equipment and operators connected with the manufacture of each lot of finished goods.

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IN setting up a manufacturing process the aim should be to make it easier, where possible, for the operator to perform the particular operations in the desired manner rather than otherwise. This contributes to the elimination of errors in processing and makes possible placing the responsibility for the control of quality, so far as operations are concerned, directly with the operating department. The necessity for process inspection is thus greatly reduced. Experience has demonstrated to the writer's satisfaction that the manufacture of rubber covered wire, where a rigid final inspection is required, can be successfully carried out on this basis, that is, with the elimination of practically all process inspection except that performed by the operators themselves in the course of processing. This is partly so because the nature of certain production operations, as for example the inspection of the wire for centering, smoothness and uniformity of insulation by the tubing machine operator. Any additional process inspection merely serves to supplement that performed by the operators and to assist them in their inspection. It is here assumed that the various operations are set up on this basis and consequently little emphasis is placed on process inspection.

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THIS paper is intended to show briefly some of the general features to be considered in process specifications and the methods of process control in the manufacture of rubber covered wire set up on the above basis. Details of either of these, it is believed, may be readily worked out from the general outline here given, keeping in mind that the essential steps in logical order are—research for the determination of standards—standardization—maintenance of standards through control—inspection of results. The rather large amount of space devoted to a description of process specifications in this paper as contrasted with that devoted to process control proper results from the fact that the main problem in process control is the setting up of properly designed specifications covering equipment, raw materials, processes and operations. Once such specifications are provided, the actual description of process control itself requires comparatively little space.

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Process Specifications

PROCESS specifications cover in detail the features of the equipment, raw materials, processes and operations which are essential to the successful attainment of a finished product of the required quality. They specify the variations in these features which the production of a satisfactory article will permit. They must be written from the standpoint of reasonably expected accomplishments in factory operations, bearing in mind that the attainment of absolute perfection in the finished product frequently is economically undesirable.

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PROPERLY prepared process specifications will be expressed in comprehensive detail, *in written form*, thus eliminating any dependence upon operators of unusual skill, or upon memory which is frequently unreliable.

IN order to make conveniently available to the operator information in which he is directly interested and to avoid confusing him with information with which he is not directly concerned, unit process specifications should be written for each type of equipment or operation and not for a complete process involving several operations. A particular foreman should have copies of all the unit specifications for operations coming under his jurisdiction.

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Equipment Specifications

THE name, number and location of the equipment should be given to avoid the possibility of incorrect interpretation of the particular unit to which reference is made. A description of how the machine is constructed, what it does and how it performs that function is essential. Detailed operating instructions covering such items as temperatures, speeds for various products, methods of charging working capacity, etc., should be given. The limitations of the machine and the sizes of material for which it is suited should be clearly stated to prevent a loss in time and material resulting from trying to perform an operation on a particular machine for which the machine is unsuited. Where tools are an essential attachment to a machine, as in the case of dies and guides with a tubing machine, the equipment specification must be expanded to include a description of these tools and their application.

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Raw Material Specifications

WHERE possible the raw materials selected for any process should be the usual commercial products of two or more nearby manufacturers. Patented materials made by only one supplier and materials made a great distance away should be avoided generally. This makes possible securing competitive bids on the materials and contributes to more economical purchasing and transportation.

RAW materials should be covered by purchasing specifications. These include the physical and chemical characteristics desired in the material and the permissible variations from these desired characteristics. The allowable limits for the usually occurring impurities should be included. The methods of analysis should be given or a reference made to a standard publication in which they can be found. The type and size of container used should be designated if that is of importance.

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FOR use of the factory, a routine should be set up to insure a supply of each raw material. This should consist of ordering more of the material when the quantity on hand reaches a certain minimum amount. This amount will be determined by the rate at which the material is used and the time required for delivery. The quantity to be ordered and consequently the storage space required will be determined in much the same way; however, the deteriorating qualities of the material and liability of loss in storage should also be considered.

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THE basis for the inspection of incoming raw materials should be defined. Whether every shipment is inspected or not will depend largely upon the size of the shipment and the reliability of the source of supply as determined by previous experience.

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Operating Specifications

AS pointed out previously the particular routine to be followed in any manufacturing process is the result of a careful study of all the factors and operations involved. This determination is the function of the development and engineering division of the organization and is set up from experimental data obtained on factory sized equipment before the process is put into actual factory operation.

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THE particular items to be described in an operating specification depend upon the nature of the process and equipment involved but in general they should include a detailed description of each step. This should include (1) the required physical condition of the equipment, such as state of repair, cleanliness, temperature, dryness, and availability of accessory tools; (2) the method of charging or set up, the size of the batch and the order in which the materials are to be added; (3) the speed, time and temperature for each size of material, and (4) the method of discharging and cleaning the machine and dismantling the particular set up.

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THE effect of the commonly occurring variables where they are important such as atmospheric humidity and temperature, time and temperature of processing, and rate of adding ingredients on the quality of the finished product should be described and the necessary precautions taken to prevent undue variations in these factors.

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THE contamination of the product during the process of manufacture may have an important bearing on the quality of the finished product and the possibilities of its occurrence should be pointed out so that the necessary precautions may be taken to prevent it. Harmful contamination is most likely to occur in the manufacture of rubber covered wire in the preparation of the rubber compound. Such contamination may come from dust in the air, grease from the mill bearings and chips of wood from containers. trucks and parts of the building. Chipping of mixing mill guides and poorly centered extruding machine screws also may cause contamination.

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MENTION should be made of the parts of the equipment that are most subject to wear or to breakage and the quantity of such parts that it is advisable to carry in stock for replacement purposes. The cost of such parts should be impressed upon the operator and instructions covering proper methods of handling them issued.

Such parts include dies for wire drawing, dies and guides for extruding rubber and lead, and parts of rubber mixing mills. In setting up such a stock list consideration must be given to the readiness with which they can be obtained.

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THE possibilities of danger to the operator or of destruction of property which require special care on the part of the operator should be mentioned. Illustrations of this include such items as (1) the danger of breaking rubber mills by adding cold compound when the rolls are too far apart, (2) the possibility of injury to the operator of a rubber mill, (3) the possibility of lead poisoning at a lead press, and (4) the danger of fire in handling rubber solutions containing inflammable solvents. In all such cases detailed instructions as to how to prevent them should be included in the process specification and the importance of their prevention impressed upon all concerned.

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THE non-uniform supply of or failure in such plant services as power, water, steam, air pressure, sources of heat, etc., have an important bearing upon the process involved in the manufacture of rubber covered wire and on the quality of the finished product. The heat supply on wire annealing furnaces and lead press die blocks, cooling water for rubber mills, mixers, strainers and tubing machines, steam for vulcanizers and wax tanks may be mentioned as important illustrations of what is referred to here. Obviously successful operation requires that all possible precautions be taken to insure an adequate supply of such services.

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FINALLY an operating specification should include a reference to the grade of labor required for each operation. This should tend to prevent paying too highly for certain types of work and conversely, serious losses as a result of using cheaper labor where a higher grade is required.

Process Control Records

HAVING now discussed in a general way the characteristics of raw materials, equipment and processes which should be covered in process specifications to make possible effective process control, we shall now turn briefly to the records which must be kept in order to derive the greatest benefit from such control.

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AS pointed out previously the purpose of process control is to maintain the standards prescribed by the process specification, or in case of failure to do so, to make possible tracing any serious variations in the quality of material in process or the finished product to their source so that their cause may be discovered and eliminated. This requires that sufficient data be kept on a process tag accompanying each lot of material so that a defect noted at any stage of manufacture can be traced back to any lot of raw material, unit of equipment or operator connected with the manufacture of the material. To keep all the necessary data to accomplish this on a single tag would in many cases be impractical so it is necessary to supplement the information on the tag by other records at various places in the factory to which the data on the tag refer. Practically these supplementary records can be developed so as to involve a minimum of clerical effort and expense by combining them with records necessary for other purposes such as with an incentive wage payment system.

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BRIEFLY this may be worked out by assigning lot numbers to each shipment of raw materials received and keeping a record in the store room of the supplier, date received and inspection results. In the bare wire department a supplementary record is kept showing the machine and operator numbers used in rough, intermediate and fine drawing, annealing and tinning of each lot of wire. The process tag then only contains this lot number. In the rubber compound room batch numbers are assigned to each batch of compound mixed and a record kept there of the lot numbers of each ingredient used, the weights of the materials, the operator who weighed it, the mill used in mixing and straining it, the operator and date mixed, together with important remarks. The process tag then so far as the compound is concerned contains only this batch number. All other information required is available on the two supplementary records. To cover tubing, the process tag shows the machine and operator number. A record kept at the tubing machine gives the weight of compound used. Under vulcanization is given the heat number and vulcanizer used. The braiding and finishing operations require the machine and operator number for each operation while supplementary records kept in these departments show the lots of raw materials used. Finally the tag provides a place for the inspector's remarks and initials or number. This tag is replaced by the regular stock tag when the finished product is placed in the stock room.

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WHILE this outline by no means covers all the operations performed in the manufacture of rubber covered wire, it shows the records necessary for effective process control of the major operations in the manufacture of such wire. From this outline suitable records for other operations can be deduced readily.

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TO illustrate how such a record makes possible tracing a particular difficulty to its source, suppose that a particular lot of wire regularly processed through the prescribed operations shows exceptionally poor electrical properties at spark or tank testing and that examination indicates that the trouble is in the compound rather than due to mechanical injury. The process tag shows the batch number of the compound used and the record in the compound room shows the lot numbers of raw materials from which this was made and the machine and operator numbers used in mixing

(*Please turn to page 364*)

The Production of Stainless Hot Rod

By E. C. Smith
Chief Metallurgist, Republic Steel Corporation

Stainless as a whole is a new product and the production of stainless rods a relatively new operation. A study of some of the problems met is presented here as a basis for discussion.

THE essential material for the production of any modern wire product is a rod of the proper characteristics. The production of such rods from stainless steels is a relatively new operation. This is mainly because stainless, as a whole, is a new product. In fact it is so recent that we have not properly placed it with relation to the ferrous industry. As a basis for making a reasonable discussion of the problem, some study of the name is in order.

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STAINLESS was the name used by the English to designate the products made from certain chrome steels. These products were mainly cutlery and the previous products were very difficult to maintain on account of rusting. The new product was an admirable solution of this problem. The name was an extremely apt designation of the product. It succeeded so well that this name has been applied to a large family of products. The name has but little relation to the present products, in fact it is a handicap to many of the present materials. The ability to maintain a bright surface under the simple corrosion conditions encountered in kitchen utensils is so small an achievement that the name hampers the material in that it does not describe even a small portion of the possibilities of the products.

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IN the main the products are chromium steels with more than 12 chromium. The original material was .30 carbon with 12 chromium. It was first worked up to solve the problem of a corrosion resisting gun barrel. It was used for exhaust valves on airplane engines very early in its history. Thus we see that very early the material was known to be both stain resisting and scale resisting. The several years that have elapsed since it was developed have not made any changes. Nearly as soon, in fact probably at the same time as the English material was developed, the German nickel chrome material was developed. Both materials have had minor modifications but in principle they remain today as they have been for more than 15 years. The chromium steel is made in two ranges. For soft steels the carbon is low and the chromium is around 18. Where hardness is desirable the carbon raises to .30 or more and the chromium may drop to 12. The nickel chromium material, while it has been applied to the hardened products, is essentially a soft stamping material. The metallurgist usually considers them as the ferrite steels; the chromium group; and austenitic steels; the chromium nickel group.

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WHILE wire and wire products have been made from both groups, the austenitic steels are so much more ductile that they lend themselves to wire drawing. The general process of making both types is so nearly identical that any description is nearly common to both. They are both products of electric furnaces. Both can be rolled or forged. Both have to be pickled in very strong solutions. The billet surfaces must be entirely removed preferably by grinding. They require about equal care in reheating, the austenitic materials are less sensitive to the heating rates and can stand a little more abuse. A discussion of the essential tools required to produce these interesting materials will be of some interest.

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THE arc electric furnace used in stainless production does not differ in any respect from that used for conventional electric furnace steels. The size of the furnace used is determined by the average requirement rather than by any limitation of process. Ordinary stainless products could be produced in the largest electric furnaces now existing and are regularly produced in twenty-five ton units. The usual order requirement seldom exceeds the capacity of the fifteen-ton unit and this, or smaller sizes, is more commonly used.

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THE melting of the steel has been simple enough and so well adapted to conventional equipment that every electric furnace operator has considered stainless a proper product for his equipment. Making the heat of stainless to the proper chemical composition is largely a matter of good weighing. Making the heat of stainless of proper metallurgical characteristics is an art and putting the product from the electric furnace all the way through to the customer is an accomplishment.

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A charge of as low carbon material as is available is melted down and if the carbon content is now below .06 the bath is oxidized until the carbon content is satis-

factory. The heat is slagged off. More than ordinary care is taken in this operation to remove all slag possible. The alloy additions which are to follow are expensive and easily held in the slag if oxidized. Every precaution should be taken to prevent loss and since one of the most effective precautions is the preparation of a low carbon heat and a proper slag-off, this is usually very well done.

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THE low carbon heat must be covered with a new slag. This is done by using burnt lime and ferro-silicon. When the heat has been under the new slag long enough to shape up and develop proper temperature ferro-chromium is added. If the shaping of the heat has been done carelessly, judging the temperature of the bath is a problem. The ferro-chromium addition is so large a proportion of the total that the expert temperature observations are of exceeding importance. The ferro-chromium is usually added in two batches. The slag becomes a crust and often lumps of the ferro-alloy lie loose on the frozen crust. When the power is put on, the whole melts quickly and there is a definite tendency to develop high heat very rapidly. At this stage the condition of the heat determines the ability of the operator to properly judge temperature.

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AS might be expected, all the precautions possible are taken to insure a good product. The value of the simplest stainless heat far exceeds ordinary steels and the higher alloy grades are extremely costly. It is natural that great care be used. All the products entering into the mix are selected, checked and accurately weighed. All the furnace operations are as precise as possible. A bad heat of stainless is an expensive calamity. For this reason, if no other, bad heats are avoided.

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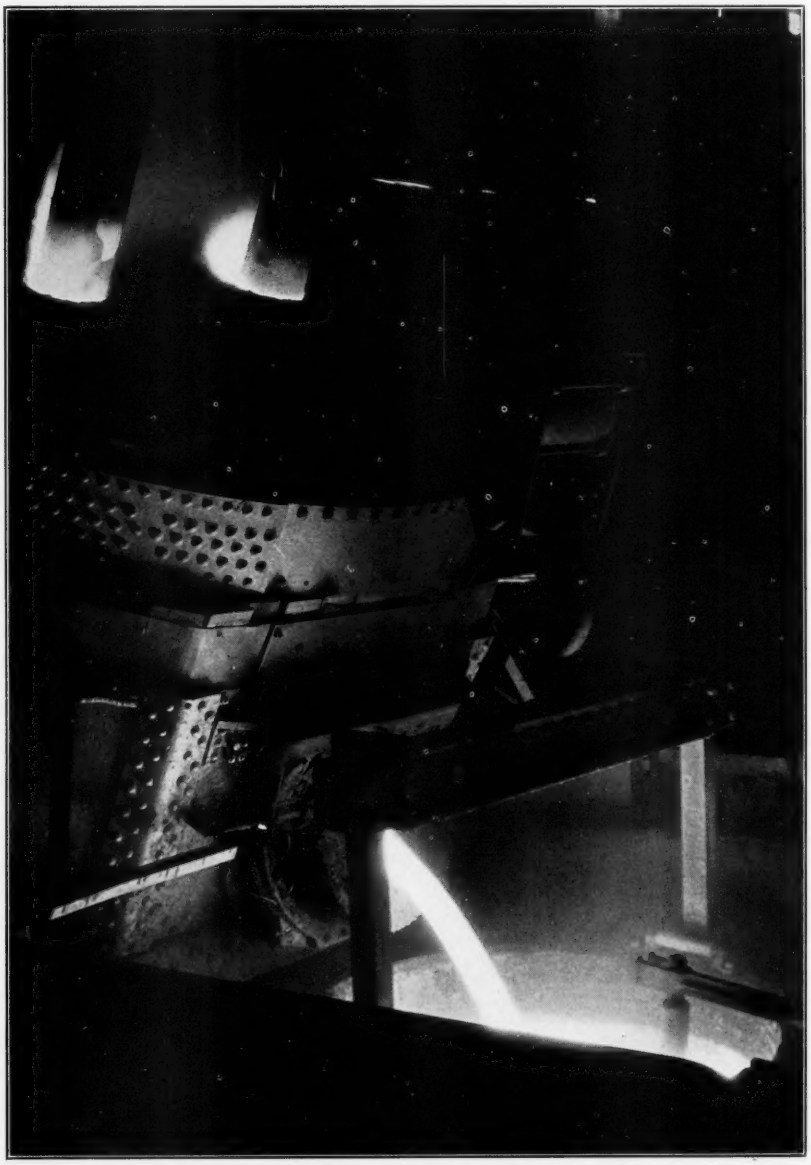
WHEN the heat is ready it is tapped into the ladle and poured in a conventional manner. In the making of simple steels, certain precautions such as tight furnaces, good roof, good bottom conditions, are observed. In stainless manufacture the equipment conditions are much more important. Stainless alloys are subject to many variables. A very interesting sidelight may be conveyed by recounting the experience reported by one foreign manufacturer. Persistent trouble in one grade of stainless was finally run down to leakage of air into the furnace about the doors. Nearly a year was needed to pin down the fact that the furnace must be under positive pressure as much as possible. In an experiment performed by the writer with a somewhat similar problem in mind the melter's comment concerning the heat was to the effect that if the experiments made did not ruin the heat he could do so by running the furnace with doors open. The usual heat of steel offers many characteristics by which one may judge the quality while still in the furnace. Stainless of any grade seems to mask the usual signs and it has been the experience of many skilled melters that heats of stainless may be made, poured and no evidence of trouble appear till the metal has been in the molds many minutes. All grades are extreme-



Pouring a heat of Enduro Stainless Steel from Arc Electric Furnace at Canton Plant, Central Alloy Division of Republic Steel Corporation. ✦ ✦ ✦ ✦ ✦ ✦ ✦

ly sensitive to moisture either in the materials or about the furnace.

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A great many designs of molds have been used to cast stainless ingots. When it is considered that the usual stainless is a dead steel with the tendency to form extremely large crystals it will be understood that casting is more than an ordinary problem. Stainless ingots are designed first with the idea of protection of the fragile surfaces and second with a view of overcoming rolling difficulties. An ingot based somewhat upon the section considered ideal of Benedicks—that is, one in which the concave faces of the ingot are so shaped that the shrinkage causes the corners to pull away from the mold has been successful in practice. The chill crystals forming in the corners are very fragile and the Benedicks type of ingot causes the corner chill to cease quickly. Fluted ingots with the flutes so designed that flute cracks are avoided are useful. For flat rolled products a slag modification of the Benedicks ingot has produced many tons of very satisfactory material. The circular ingots of some of the foreign plants which were turned all over before rolling were peculiar to their conditions rather than necessary by virtue of the character of the product. As presented before, the care is in line with the value. In the case of ingot designs and ingot handling for stainless steel the problem is magnified many times by the different freezing characteristics of the product and by its extreme tendency toward large fragile crystals. The pouring conditions should be as nearly perfect as possible.

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IN the production of billets for wire rods the ingot required is very small. This simplifies the problem very much. Large stainless ingots of the austenitic chromium-nickel type are easily handled but large ingots of the plain chromium steels are very difficult to handle since they are very fragile when cold. This problem while minor in wire production is of considerable interest from another view point. Since the chromium-nickel steels are easily handled as cold ingots, stocks can be carried in the ingot stage. In fact the European practice was to produce all ingots for stock. Round ingots were cast, cooled and turned to remove all surface material. It is easily seen that the problem of inventory is much simpler with the chromium-nickel product. Another factor influences the user in favor of the chromium-nickel material. Surface decarburization is very much more of a problem on the plain chromium material. The total of all these factors is to place a decided advantage in favor of the chromium-nickel material. This advantage so nearly overcomes the higher cost of the material, that for wire the chromium material is hardly on an even basis in spite of its lower cost.

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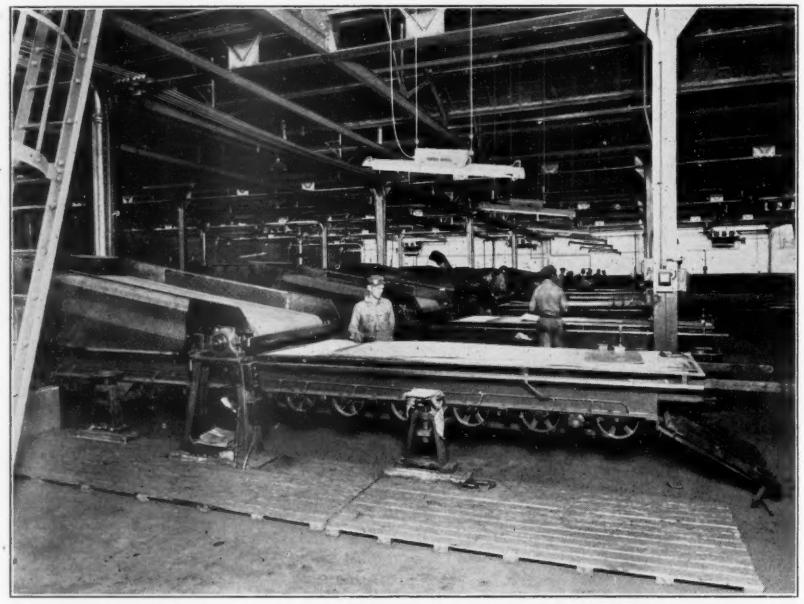
ALL the stainless steels are highly alloyed and as such are remarkably low in their rate of heat conductivity. The thermal history after solidification is therefore different at least in time element, from simple steels. A hot ingot of 18 chromium 8 nickel 350 square inches cross section requires about 9 hours of extremely careful heating before rolling. Any attempt to push or rush is paid for in surface defects. The 18 per cent chromium is easier to handle but requires double the heating time of the ordinary alloy steel. The future heating arrangement for these steels will most likely be the one way fired recuperator equipped pit. The very satisfactory quality of heating possible in this type of unit is easily shown with these steels. The very long cycles will demand insulation and recuperation of the highest quality.



General view in Enduro Polishing Dept., Massillon Plant of Republic Steel Corp. ✦ ✦

NEARLY all this family of steels are heat resisting in that they scale very slowly. They are difficult to heat because they have very narrow ranges in which they must be soaked if they are to roll. Pyrometric measurement of temperature is so essential that it has become standard. The chrome nickel of the 18 chromium 8 nickel type is subject to a varied set of limitations. When low in carbon it is a two phase material as cast, the magnetic delta phase being present along with the non magnetic gamma phase. If the ingot has been permitted to become cold the heating up to red must be done slowly enough to prevent rupture of a very coarsely crystalline material with a very low conductivity. After the ingot is hot enough to insure ductility the

temperature can be increased fairly rapidly but an upper limit of 2300° F. must be observed. The delta phase present as cast must be put into solution. This starts at 1800° F. and is rapid at 1950° F. to 2250° F. Above 2300° F. the reaction reverses and the delta appears again to produce a very hot short material. Since no surface evidence is visible the pyrometer must be used and depended upon. If high temperature is not used the low thermal conductivity causes a long heating cycle, if the top temperature is exceeded the destruction is very rapid. The customary heating time from cold to rolling temperature is well in excess of one hour per inch cross section. Ingots 350 square inches cross section are regularly under fire more than 24 hours if they have been cold. Hot ingots of the same size charged in the pits about 1½ hours after pouring, require 9 hours heating to insure good rolling.

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THE straight chromium irons are simpler to work since they act more like ordinary steels except for their low conductivity. They are subject to the limitation that rolling must be done rapidly to conserve heat. The exposed portions cool and the low thermal conductivity causes the outer portions to remain low in temperature. Since all of these highly alloyed steels are much stiffer for any given temperature, cracking starts quickly due to lack of ductility. While the straight chromium irons are fairly easy to work, all the other members of the stainless family are difficult to roll. The addition of silicon to these steels causes an increase in handling difficulties. The addition of the many other elements causes really serious complications. To call attention to the problems, an example may be given by a discussion of a chromium-nickel-tungsten of the type of 18 chromium 8 nickel and 3 tungsten. This steel is stiff and there is a tendency to heat high to hasten the production. If the heat is raised the product promptly breaks up. The upper range for working may in some cases be as high as 2100° F. if the manganese is over one per cent. The lower range at which the stiffness causes breakage is about 1900 degrees. This narrow range does not permit rolling in the accepted sense. Forging is resorted to in breaking down the ingot. Rolling in the bar stages must be done in lengths and sizes that will permit finishing in the temperature range which permits working. To determine

Large vitrified Wheel for removing defects from Enduro Stainless Billets in Republic Steel Corporation Plant. ✦ ✦ ✦ ✦

the working ranges and adapt the equipment to them has been a trial and error development.

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THE 18 chromium 8 nickel austenitic series work over a wide range as noted above. Power to move is nearly the only factor if the steel has been soaked carefully. The 18 chromium series work over wide range but do not work if the surfaces are decarburized to any serious depth.

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WITH the exception of silicon in amounts less than 1 per cent, additional alloying usually narrows the working range of the 18 chromium or the 18 chromium 8 nickel to a point where forging is more satisfactory. The high chromium 25/28 per cent chromium is better forged, using many heats and working from 2000° F. to 1850° F. The 25 chromium 12 nickel 1 silicon series is forged from about 2150° F. to 1900° F. The 25 chromium 20 nickel is forged from 2200° F. to 2000° F. In all cases the forging must be done in a manner that prevents exposed corners. The usual practice is to go over the entire ingot surface lightly, working in any exposed corners. The usual working shape is an octagon or a round cornered octagon. A great number of heats are taken to insure working well within the ductile range. With all precautions the surface is usually far from desirable.

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IN preparation of surface of stainless alloys two things are encountered. The surface is full of small defects due to the limited scaling and consequent lack of removal of the very small scabs and cracks. The decarburization is usually followed by very large crystalline grain growth which is very fragile. For this reason it is necessary to remove not only the visible defects but also enough of the underlying material to insure a surface that will roll. The amount removed varies but usually and arbitrary depth of metal is removed. The European practice was to machine about ½ inch depth from surface of ingots less than 16 inches across. American practice favors removal of billet surface and this is best done by grinding. Chipping is resorted to on the austenitic steels where very heavy forgings are to be made, or the surface of the bar removed by turning. Machine removal of the whole surface is sometimes done with milling machines or planers. Grinding is the method usually used and is best done with powerful high speed grinders. If the usual surface removal is all that is required a high speed wheel using an organic bond is used. The grit will depend upon the surface required but much of the work is done with about 16 grit rubber bond whels traveling at a speed of about 9000 surface feet. If much rough work is to be done vitrified bond wheels with coarse grits and slower speeds are used to rough. In either case the bond must be such that the wheel does not glaze. Surface preparation of a product that is to be used for decorative purposes is a task.

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THE commercial handling in the bar mills and rod mills of the ground stainless billets is an interesting problem. The material is very valuable. The raw billet may be worth twenty times the price of steel in most cases even the scrap is worth three to five

times the value of ordinary hot rod of simple steel. It is reasonable to expect that much attention is given to such material. The attitude of the men must be altered. Those who have worked with the precious or semi precious metals develop a characteristic attitude that scrap must not be produced. It becomes perfectdy normal to subordinate every other factor. Hours of labor by men with a very high degree of skill are common. A small lot is literally fussed with until it is finished. This mental attitude is encountered in all the usual non-ferrous industries. Consider for a short period that if the product under discussion had not been named stainless steel it might have been called by a designation that would convey to your mind a hard white alloy very similar to the copper nickel zinc alloys known as kickel silver or german silver. If for the time being we might forget completely that we had steel and realize we were working with essentially a hard single phase solid solution metal the physical problems are more clearly indicated. In a steel mill the outstanding problem is human. The material is so essentially foreign to the tonnage steel man's mind that he finds it very difficult to appraise the problem. The tool steel man who has worked expensive materials by methods which have been determined largely by experience is more at home. For this reason it is but natural that what seems an old fashioned mill layout and an ald fashioned crew are more desirable in handling this material. The small tonnages involved do not upset such units. The extreme care in handling does not irritate the men. The attitude of mind that makes almost a religious rite of each operation is of so much value that the nearly automatic big mill layout is nearly impossible.

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THE most satisfactory plant equipment is a special small scale layout, usually hand mills. The furnaces must be of ample capacity to account for the low heating rate. It is usual to find even the tool steel heating methods too fast for proper soaking of such materials. In usual practice the heating must be slow until the grain growth temperatures are reached; providing for thorough soaking and rapid heating from grain growth temperature to rolling temperature. The heating cannot be done by rushing to the rolling temperature and soaking there since the time required to soak to the center will cause decarburization or grain growth and usually both. Small lots of steel, good pyrometric observation and small batches working to insure proper handling before the next lot is in the critical stage are only sensible precautions. The mill layout and method of rolling must account for certain characteristics of the product. Since the heavy jacket of scale common to ordinary steel is not present the surface is easily marred. Any sliver or scratch or mark is not immediately smoothed over by the oxidation of the surface. And sheared portion does not oxidize off; it remains to be worked in or dragged off in guides, or the floor. For this reason the guide mill method is less desirable than the hand round. The finest of the tool steed practices are justified and should be used where possible. Since all the more important bar sizes can be produced by the hand round method and the smaller sizes by very well handled guide mills, only the rod sizes are subject to the definite habard of fast reduction and tight guides all the way. Rod sizes are best produced by using billet sizes as small as possible and producing relatively heavy rods. Each coil should be inspected as produced to make sure the guides are clean. This slows the production very definitely. Careful operation of a mill will permit production of rod sizes down to ¼ inch and considerable material is produced as small as .220 inch where the surface and section can stand some slight defects. Where the combinations of chemistry do not permit wide ranges of working temperature the only recourse is to very small billets and very rapid work with a limited number of passes.

THE hot rolled rod from the mill will vary in weight according to the mill capacity. It is usually a very small coil compared to simple products. It is very hard, resembling very high carbon wire in its physical qualities. As stated before, it is very expensive. The precaution noted earlier of seeing that each coil is clean as produced,

Swing Frame Grinders for Enduro Stainless Steel in Republic Steel Corporation Plant. ✦ ✦

is but insurance that much scrap is not made before the mill is corrected. If a rolling has no defective material it is ready for further processing. The next stage is the softening anneal. This varies with the product. The plain chromium materials usually have been cold worked and partially quenched. They are therefore partially cold worked ferrite mixed with some martensite. The anneal temperature, time and rate of cool must be so balanced that the material is soft ferrite of the proper grain structure. The chromium nickel materials of the austentic type require a radically different treatment. The carbides must be dissolved and they usually are held in solution by rapid cooling. The final material is soft austenite.

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THE plain chromium material is placed in pots or may be sent through a continuous anneal. The temperature is very close to 1500°F. The rate of heating and cooling is governed by the final requirements. The more usual method is the pot type furnace. The rate of cooling is quite slow since the material is desired very

(*Please turn to page 366*)

Plant Efficiency

By J. C. Callaghan, Works Manager

Canada Works, Steel Company of Canada, Ltd., Hamilton, Ont., Canada

No Plant Can be Efficiently Operated Without Proper Control and General Orderliness. Accident Prevention is a Real Factor in Successful Operation. ▼ ▼ ▼ ▼ ▼ ▼

I APPRECIATE very much the honor of having the privilege of leading the discussion on the subject of Plant Efficiency, although I approach the task with a certain amount of diffidence. When I was asked by your Committee to undertake this duty, I felt that whatever reluctance I might have should be submerged, and that I should, in as simple a way as I could, present several points of interest that could be enlarged upon during the discussion that might follow.

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THE subject is one that can be all-embracing, taking in so many factors in the manufacturing routine that in the short time at our disposal we would get nowhere unless we confined our remarks to certain fundamentals. Whatever I may say, or infer, is to be related to the Wire Industry, which, as you all know, carries a definite hazard, personal, financial and economic.

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DURING the past 15 or 20 years the progress in plant efficiency has been remarkable. Many engineers have made definite and outstanding contributions to the formulae that have improved the general efficiency of industry. In the different phases of industry, however, that of wire has not perhaps received the same attention, or study, as it warranted.

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I WOULD like to add at this point that I believe the Wire Association has given a great stimulus to a more intensified study of the various problems of efficient operation in the wire processes. While to many, it may appear long delayed, yet the fact of so many wire men here today at this convention, even in such depressive times, is ample testimony of the contribution the association is making.

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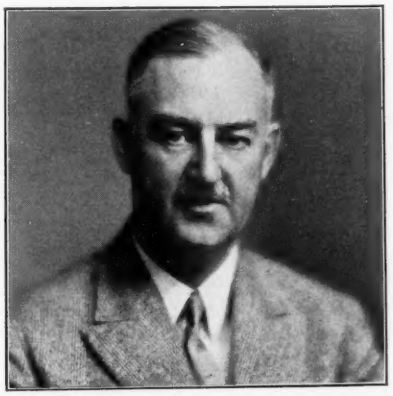
PRACTICAL application of improved plant efficiency has tended towards centralization both in control and direction. While this has possessed certain advantages, yet with it has come a definite tendency to circumscribe the development of initiative in the individuals, particularly those in the subordinate positions, which tendency has been conducive to atrophy both of individual judgment and inventiveness. What progress has been made in efficiency routine and methods in the wire industry has, we can assume, been through centralization of control and mechanical invention with less attention being given to the great potential reserve of initiative and invention of the individual holding routine responsibility.



J. C. CALLAGHAN,

Works Manager, Canada Works, Steel Company of Canada, Ltd., Hamilton, Ont., Canada, Member: Wire Association.

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THERE is a possibility that in the next productive period, that we are bound to enter, that those in position of management who will give more study to decentralization of responsibility, who will be interested in preventing the atrophy of individual initiative, will tap a great potential force, that, if used properly, will make further contribution to improving the efficiency of plant operations.

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IF it is true that in the enlarging of plants and plant organization that control has been more and more centralized, that individual opinion has become more circumscribed, that, in turn, initiative and invention may not, and I am speaking generally, be given that scope or opportunity to meet new conditions promptly as they arise, we can also appreciate the fact that any sensible medium that will bring out individual resourcefulness and broaden the responsibility of the individual will permit us to come closer to our employees as individuals, and by that means perhaps keep more active those individualistic qualities of resourcefulness and invention that should form an important part of a personnel. Such a medium is that of definite personal interest in Accident Prevention and Personnel work among the employees.

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WHILE I believe that all real constructive work of Accid-

ent Prevention and Personnel starts at the head of any organization, yet it is necessary to see that it is properly disseminated through the entire organization down to the subordinate individual. If such a routine properly functions, the whole organization becomes bound together in definite personal contact and understanding.

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THERE is no doubt that we all feel a kindly regard in varying degrees for our fellow workmen. We cannot help but appreciate the fact that they have their problems, their successes, their failures and disappointments, and that they, as individuals, are endeavoring, in the majority of cases, to perform their part and responsibility in the routine that provides them their livelihood.

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THE point I want to stress particularly is that, while charts, statistics, basic costs, etc., are necessary for the careful control of our business, yet if our minds work through the avenue of that of personal interest in the employees who form our organization, and if we use the medium of Accident Prevention and Personnel work for a closer personal contact, I believe our general plant efficiency will definitely tend to improve.

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WITHOUT bringing into the picture any sentimental aspect, but confining ourselves purely to that of appreciating the capacity, skill and ingenuity of the individual who forms part, and an important part, of plant efficiency, we will keep our thoughts on the individuals rather than on the group, and accentuate the value of definite personal contact, which we cannot fail to admit is the primary stimulus to an understanding of just what plant efficiency means. Our primary object cannot help but be that of so utilizing the efforts of the individuals who comprise our organization that the net result will be one of profit to both the company and to the individual in that organization. Without this healthy and normal basis, inefficiency in its various forms can readily make its appearance through the resistance, disinterest and ignorance of those individuals in the organization who do not get, or think they do not get fair or reasonable treatment in the general result.

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WHILE the first impression among workmen when Accident Prevention and Personnel work is emphasized is that of questioning the motive, it will take time to give evidence that the responsibility must be shared all the way down through the organization, and the workmen must become quite conscious of their responsibility and the part they play in protecting those with whom they work, as well as protecting themselves.

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WE can take it as a truism that no plant can be either efficiently managed or operated if there is not that condition of general orderliness and if there is not a complete appreciation of just what good housekeeping really means. Good or bad housekeeping is, no doubt, to most of us relative terms, the terms, the meaning of which change the more we put good housekeeping into actual practice.

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INTEREST in good housekeeping directs attention to the problem of inventory control, storage, facilities, well-defined areas for manufacturing, proper bins and lockers, orderly tool cribs and a reasonable application of paint in a proper color. The care and repair of trucking areas require consideration as they have an influence on the cost of moving material as required in the production operation. This has a distinct bearing, also, on the safe movement of material and in reducing of hazards to those engaged in that part of the work. When, in improving the trucking areas, they reach a state of repair, where trucking economies can be shown, attention can be easily continued to the general condition of the floors in and around the machines. If the interest is both critical and sustained, it will be an easy task in even supposedly well organized and managed plants while studying safety conditions in and around the machines to find scrap and refuse in places where they should not be. If a localized consciousness to the fact that scrap is both expensive and a distinct loss, and that someone is reasonably responsible to see that it is neither made nor left in that particular spot, it will necessarily follow that some thought will be given to the causes of the production of such scrap. It is the rare and extreme case where any study has been given to the constructive reduction of scrap or waste that some definite progress is not shown. In the study of the elimination of waste, it can be continued by the same individuals who are interested in Accident Prevention work and who are the individuals responsible in the areas concerned, that is, if the accident prevention problem has been seriously attacked and the personnel properly lined up.

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THE equipment on which the product is produced and the material which is used to make the finished product, including the specifications against which the material is purchased or produced in previous operations will come under more serious scrutiny and consideration. The individual operating the machine and using the material will also be more carefully considered, and his efforts in producing product and the waste will have been placed in a more comparative category.

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ON dealing with the individual operating the machine, the Accident Prevention mind will naturally check up the hazards which may have a distinct bearing on the worker's efficiency, on the ability to pursue the various parts of his task in the proper manner and in the proper sequence. The health and capacity of the workmen will be given more consideration, and a conclusion arrived at as to the proper type of workmen to be selected for the machine operation and the particular hazard of production.

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THE problem of waste reduction brings in another vital factor, that is proper illumination. Proper illumination may be considered by

(*Please turn to page 364*)

PROGRAM

Monday, October 3, 1932, at Hotel Statler

A. M. and P. M.--Registration -- "Get Together" P. M.--informal meeting at headquarters of The Wire Association

These meetings will be held every night from 8 to 11 o'clock during the convention.

The Technical Sessions

Program Committee

Ralph K. Clifford, Gen'l Supt., Continental Steel Corp., Kokomo, Ind., Chairman

Kenneth B. Lewis, Morgan Construction Co., Worcester, Mass. W. D. Pierson, Sec'y. Waterbury Farrell Fdry & Machine Co., Waterbury, Conn.

R. E. Brown, Secretary, The Wire Association, 17 East 42nd St., New York, N. Y.

THERE WILL BE A REGISTRATION FEE OF $5.00 FOR THOSE ATTENDING THESE SESSIONS.

Stenographic Copies of the Discussions Will Be Available at $2.50 Per Copy.

At the technical sessions to be held Tuesday, Wednesday and Thursday, the papers will be brief and will be limited to one per session. It is intended that the time shall be spent in open discussion and exchange of experience in matters of general interest to wire mill operating men.

The discussions will cover, so far as time permits and in addition to matters arising naturally out of the papers read, a number of topics which have been suggested by members. The program committee will be glad to receive other suggestions. These topics are listed in the program schedule below.

Tuesday, Oct. 4, 1932

KENNETH B. LEWIS

Morgan Construction Co., Worcester, Mass.

Chairman of Meeting

Morning Session—at Hotel Statler at 9:30 A. M.

Paper A—"WIRE DRAWING AS A HANDLING PROBLEM"

By L. D. Granger, Asst. to Vice-Pres., Wickwire Spencer Steel Co., New York, N. Y.

Additional topics for discussion:

1. **ACID STORAGE—What tonnage justifies purchase in tank cars—how to store muriatic acid. Sulphuric in steel pickle tubs with inhibitor—rubber lined tubs for pickling—acid proof steel—effect of inhibitor on finish—accelerated cleaning by moving rods—agitation of acid by air—temperature regulating devices.**

2. **LIME—Under whose supervision—how closely checked—permissible content of silica and magnesia—any other properties tested for—standards for heavy, medium and light lime—how checked for lime value while running—what causes deterioration in use—when dumped on what test—what consumption per ton wire—where does it go—is waste lime salvaged—can you get heavy coat from light lime tub by redipping—substitutes for lime.**

3. **CLEANING LAYOUT—Straight vs. circle, what arguments for each**

   (A) MASONRY TUBS—what size tile—glazed or not—what binder—how is top rail secured—how full is tub worked—Single long tub or partitions.

   (B) CRANE—bridge, gaintry or monorail—motors high or low—electrical spares—tonnage cleaned per line—what limits it.

   (C) HOOK—Full swivel and tilt, or rigid type lifted at 2 points—advantages of each.

   (D) SULLING—How long?—why does this vary from mill to mill—effect of lime in water—steam coat—acid coat—sulling and re-coating of hard drawn wire.

   (E) DUNN—Process of electrolytic cleaning.

Afternoon Session—2 P. M., at 174th Regiment Armory

Paper B—"PLANT EFFICIENCY"

By J. C. Callaghan, Works Manager, Canada Works, Steel Company of Canada, Ltd., Hamilton, Ont., Canada

Paper C—"COST ACCOUNTING"

By R. F. Cohn, Plant Manager, The Reynolds Wire Co., Dixon, Ill.

Additional topics for discussion:

4. FOREMEN'S MEETINGS—How often—what discussed—to what extent are cost sheets shown and discussed—to what extent understood—are outsiders invited to explain cost system—regulations as to goggles and gloves—general set-up for safety.
5. BAKER—should wet rods enter hot end first—preheated air and forced circulation—how hot and how long time compared with old practice—what troubles—should air be bled out or recirculated—is steam heated air hot enough—what is the minimum baking time for good market wire—how promptly should wet rods reach baker.

Wednesday, Oct. 5, 1932

Non-Ferrous Sessions

W. D. PIERSON
Secretary, Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.,
Chairman of Meeting

Morning Session—9:30 A. M. at Hotel Statler

Paper D—"COPPER ROD ROLLING, WIRE DRAWING AND ANNEALING"

By John R. McKean, Supt., American Electrical Works, Phillipsdale, R. I.

Paper E—"PROCESS CONTROL IN MANUFACTURE OF RUBBER COVERED WIRE"

By E. G. Sturdevant, United States Rubber Co., Bristol, R. I.

Additional subjects for discussion:

6. What is a Vacuum Drier and why and how is it used?
7. Is there any difference in the quality of the ingots used for making fine wire, say No. 38 and smaller, or in the method of rolling or drawing, and is there any way to distinguish the good ingots from the bad?
8. On single hole work, what is the minimum number of drafts from the rod with which it is possible to produce good wire as to finish etc., without regard to any tensile strength requirement?
9. What is the effect of tensile strength of hard drawn wire of diameter of rolls ,slip, dip temperature, etc.? What, if any, is the limitation of a continuous machine for making A. S. T. M. specification wire?
10. Can tungsten carbide dies be successfully used in conjunction with diamonds in the same set up? What is the smallest size tungsten carbide die recommended for copper? Are tantalum carbide dies considered satisfactory for copper?
11. Are any definite figures available as to die costs per 1000 lb. of wire drawn, both in tungsten carbide and diamond dies?
12. What is the usual percentage of scrap in drawing wire and to what extent does it increase operating costs? How does the percentage increase with the fineness of wire drawn?
13. What is the proper annealing temperature for fine wire?
14. Why does such a difference exist in opinion as to the proper tightness of the winding of a spool of fine wire, and at what size does the tightness become a very important factor?
15. Is there anything in the theory that in drawing fine wire it is desirable to split the drafts after perhaps No. 38?
16. It is considered good practice to anneal somewhere in process when making fine wire? If so, what is the smallest size to be made without annealing?
17. What does it cost to anneal wire?
18. For annealed fine copper wire, what is the comparison between annealing on metal spools and passing spooled hard drawn wire at a comparatively low speed through an annealing furnace and respooling? How fine is it possible to go on the latter?
19. In drawing fine copper wire, say No. 36 to No. 40 B&S, on a continuous machine, is it a better proposition to operate 12 to 16 dies, or start at a heavier size and operate 20 to 22 dies?
20. What is the usual practice in drawing speed for brass, bronze and German silver as compared with copper, also the number of dies which can be operated without annealing?

Thursday, Oct. 6, 1932

RALPH K. CLIFFORD

General Supt., Continental Steel Co., Kokomo, Ind.
Chairman of Meeting

Morning Session—9:30 A. M. at Hotel Statler

Paper F—"PATENTING OF RODS AND WIRE"

By R. B. Whyte, General Supt., The MacWhyte Company, Kenosha, Wis.

Additional topics for discussion:

21. DIES, TUNGSTEN CARBIDE—What records kept of issue and return—Is there more skin-hardening effect than from other types of die—Is water cooling advantageous?
22. SOAP consumption per ton—regulations of issue—individuals checked—what proportion wasted—what moisture allowed—is soap useful in process drafts—lubricating plugs—do they feed more soap—is this desirable—does it affect die-pull or life of coating?
23. CAST IRON DIES—Average re-cuts per hole—effect of high polish—largest safe hole for given weight of die?
24. GAUGE SYSTEMS—How many wire-drawers carry micrometers—what percentage wire tested by micrometer—what prevents dropping of gauge numbers—is there anything beyond trade practise—can these objections be met?

Afternoon Session—2 P. M. at 174th Regiment Armory

Paper G—"THE PRODUCTION OF STAINLESS HOT RODS"

By Earl C. Smith, Chief Metallurgist, Republic Steel Co., Youngstown, O.

Additional topics for discussion:

25. NAILS—How heavy bundles on reels—how far can helpers be eliminated by heavy bundles—life of knives and dies in continuous running—elimination of tote boxes—to what extent tried—what saving in helpers—what objections.
26. TUMBLERS—What speed—what limits speed—how full and why—speed and stroke of shakers—what determines it—disposition of nail whiskers—standards in head and point.
27. CONTINUOUS MACHINES—What is minimum number of drafts profitable—What is maximum on one machine—What average output gain—Effect on handling—can good market wire be made—how about percentage scrap—attitude of labor—floor space—safety-die life—effect on high carbon wire?
28. TINNING—What limits speed—Does tin kettle affect hardness of drawn wire?

Friday, October 7th, 1932

10 A. M. At Hotel Statler

Annual Meeting of The Wire Association

Presiding—John Mordica, Supt. Rod & Wire Mills, Bethlehem Steel Co., Sparrows Point, Md., President of the Wire Association.

Discussion of Industrial Preparedness Plan for The Wire Industry—Major Richard E. Brown, Spec.-Res. U. S. A.
Report of Industrial Preparedness Committee—L. D. Granger, Chairman
Address By Representative of War and Navy Departments
General Business of the Association:—
Election of New Directors
Financial Report
Plans for 1933 Meeting
Reports of Committees
New Business.

▼ ▼ ▼ ▼ ▼ ▼ ▼ ▼ ▼

MAKE YOUR PLANS NOW TO ATTEND THESE MEETINGS!

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RICHARD E. BROWN, Secretary

THE WIRE ASSOCIATION, 17 EAST 42ND STREET, NEW YORK, N. Y.

Eleven Plants In and Near Buffalo Open Doors Wide to Metal Congress Visitors

Busses will leave from the Delaware Ave. entrance of Hotel Statler daily at 9:15 a. m. except for the visits to plants at Niagara Falls. These will leave at 8:15 because of the greater distance to be travelled. Tickets may be purchased at the Hotel. Please buy them one day in advance.

Tuesday, Oct. 4

BLISS & LAUGHLIN, INC. Visitors will see modern equipment for cold drawing round, squares, hexagons and flats. Also turning mills in which large rounds are turned to size and centerless grinders for producing rounds with extremely accurate size and highly polished finishes. This plant also has modern facilities for pickling, straightening, polishing and cutting.

AMERICAN BRASS CO. The processes at the Buffalo plant include electric furnace melting of copper, zinc, lead and tin for a variety of brasses and bronzes which are rolled into sheets and drawn into tubes. Commercially pure copper cakes and billets from the refiners are rolled and drawn.

PRATT & LETCHWORTH CO. This plant has modern malleable and steel foundries with facilities for melting, rolling, carburizing and heat treating. There is also a small forge shop and a new and most modern spring plant for manufacturing hot wound coil springs. The spring plant is operating only at night, but arrangements for visiting can be made at the A.S.S.T. registration desks at the Statler and at the Armory.

Wednesday, Oct. 5

BETHLEHEM STEEL CO. The Lackawanna plant is a complete and modern mill with blast furnaces, bessemers and open hearths. Twelve rolling mills produce blooms, billets, sheet bars, rails, structural shapes, plates and bars.

NIAGARA FALLS TRIP

U. S. L. BATTERY CO. This is a complete plant for the manufacture of storage batteries, car lighting equipment and electric welding apparatus.

NIAGARA FALLS POWER PLANT. A total capacity of nearly 500,000 h. p. is the rating of this plant, which produces more power than any other hydro-electric plant in the world.

Thursday, Oct. 6

REPUBLIC STEEL CORP. The Buffalo division of this corporation is a modern well located plant with two blast furnaces, nine open hearths, one 38″ blooming mill, one 18″ continuous billet mill, 10″ and 14″ bar mills, and cold drawing and die rolling departments.

BUFFALO BOLT CO. Over 75 years experience and a capacity of 1,500,000 bolts and 2,500,000 nuts per day characterize this plant which occupies 23 acres. Departments include rolling and wire mills, cold heading and cold punching, hot forging and hot punching, automatic pointing, threading and nutting, heat treating, electro zinc, cadmium and lead plating, hot galvanizing, parkerizing, machine shop and tool making.

Friday, Oct. 7

CURTIS AEROPLANE MOTOR CO. This is the largest plant in the country devoted exclusively to aircraft. Only military planes are produced, both for the United States and for foreign governments. The plant has the largest wind tunnel of any commercial organization.

PIERCE ARROW MOTOR CAR CO. Those who visit here will see all machining divisions and the tool room, motor assembly, body mill, body frame, body sheet metal, interior trim, paint and final assembly departments.

SENECA IRON & STEEL CO. This modern, well equipped sheet mill has a capacity of 15,000 tons per month of all grades of sheets including black, deep drawing, furniture and full finished auto body. About 70% of the production is auto body grade.

A Radical Improvement in Tungsten Carbide Dies

IN the few years that tungsten carbide dies have been available for wire drawing much has been done toward improving them, and increasing their field of usefulness. The material itself has been improved by careful laboratory work, die designs and manufacturing methods have been altered for the better, and the sum total of these advances has given the users much more satisfactory service than seemed possible at the inception of the new industry.

✦ ✦ ✦

ALTHOUGH the new material from the beginning has proven a great boon to all classes of wire drawers, especially the drawers of high grade steel wire in the smaller sizes, there have been certain disadvantages which have tended to work against its wider use. The principal disadvantages have been high cost from an investment point of view and in some cases actual higher die costs per ton, and uncertainty of costs because of breakage in use.

✦ ✦ ✦

IT is quite true that these disadvantages are more than offset by corresponding advantages such as better wire and lower labor costs, but undeniably many more tungsten carbide dies would now be in use if these costs were lower.

✦ ✦ ✦

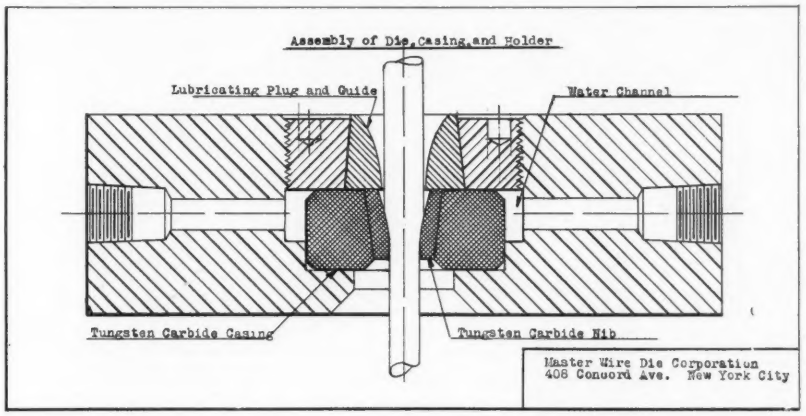
THE cost of tungsten carbide dies is due to a number of factors: the raw materials are comparatively expensive, the laboratory work on the tungsten carbide blank including handling costs, mould costs, fuel costs, and breakage in process, is extremely expensive. Little can be done to lower these costs if quality is to be maintained except the natural reduction from increased volume. The unit price of tungsten carbide made into die blanks, or 'nibs" in trade jargon, is from the very nature of the material and process, bound to be high.

The problem therefore resolves itself into doing the greatest possible amount of work with a small "nib."

This condition has been set up to the present time by setting the expensive "nib" in a casing of cheaper material, usually tool steel, pressed, shrunk, cast or forged around the nib. The functions of the casing are to preload the nib against tensile stresses in the nib set up by the drawing operation, and to provide a conveniently sized tool for handling and securing in the wire drawing machine.

The casing, which if carefully made is comparatively expensive, is only used during the life of the nib and is not salvagable. Without regard to the method used in applying the casing, it is impossible for a casing of the material usually used to reach a very high degree of efficiency as a supporting element because the great difference in ultimate compressive strength between the materials, approximately 500,000 lbs per square inch for tungsten carbide and 150,000 lbs. for the casing material precludes the possibility of adequate bearing.

Another objection to the casings used in present practice is the great difference in the co-efficient of expansion of the casing material and the tungsten carbide nib, that of the casing material being about 60% greater than tungsten carbide. It is obvious that the heat generated in drawing when transmitted from the nib to the casing would tend to lessen the support afforded the nib by the casing.

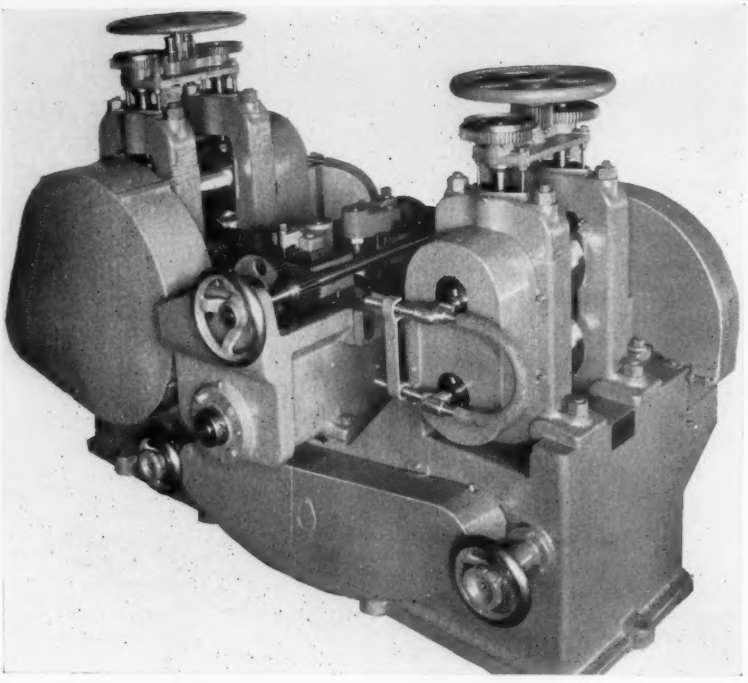

Assembly of Die, Casing, and Holder
Lubricating Plug and Guide
Water Channel
Tungsten Carbide Casing
Tungsten Carbide Nib
Master Wire Die Corporation
408 Concord Ave. New York City

TAKING all these items into consideration, consciously or not, and in addition, the fact that to draw wire successfully it is necessary to have a lubricant lead or funnel extending beyond the point where the incoming wire impinges upon the cone of the die, a practice has been worked out by costly experience whereby tungsten carbide die manufacturers can guarantee a nib with reasonable safety to perform specified work.

For the reasons previously outlined this nib size must be great enough to provide height for the lubricating funnel, and strength to make up for the deficiencies of the casing. In other words, the user must pay for a casing which is only used once, and then pay again in extra tungsten carbide to make up for the lack of value in the casing. The extra nib height required for the lubricating funnel of tungsten carbide is comparable in price and fitness with mak-

(*Please turn to page 368*)

Flat Wire Rolling Mill



10″ Breakdown—5″ Edging—8″ Finishing Rolls Driven by 40/50 h. p. 3 to 1 Variable Speed Motor. Capacity 150 to 450 ft. per minute. Wire Straightening rolls, scarfing attachment, guides between rolls and Take-up strand to suit customer's needs.

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Designer of Special Machinery for Rod, Wire, Tube, Strip and Cable.

107 Colden Street Newark, N. J.

Wire Drawing as a Handling Problem

(*Continued from page 327*)

THERE is one fundamental principle, however, that is true regardless of price of labor, interest, or rent, and that is, as the service or handling time is reduced, production per man is bound to increase regardless of any other considerations whatsoever, provided sufficient equipment is furnished.

✦ ✦ ✦

YOU must also consider the quality of wire to be produced. Can high strain, high twist rope wire be satisfactorily made on continuous machines, or must this be drawn on single blocks? How much off sized wire or scratched wire will be produced? What is the comparative die cost?

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NO subject in the wire drawing field has evoked more discussion than the advantages and disadvantages of the continuous process, and we hope that the matter may be fully and frankly discussed here, and that we may perhaps know more about the facts than we ever have before.

✦ ✦ ✦

JUST as a parting thought, I want to draw your imagination to a purely theoretical mill. This mill has bundles of rods welded together into continuous lengths of 8000 pounds. The wire is drawn on continuous machines which do not build up, and on which the dies do not wear out. The wire is taken off in 500 pound bundles, which requires one minute per bundle. It takes 7 minutes to string up the machine to start. A simple calculation shows that the servicing time is 7 minutes for stringing plus one minute for taking off each of the sixteen 500 pound bundles, making a total of twenty-three minutes per 8000 pound length. Therefore, if a man works 600 minutes per day, he could service twenty-six bundles. As each bundle weighs 8000 pounds, he would have a production of 208,000 pounds a day. Quite a step from the usual 6000!

✦ ✦ ✦

Wire and Wire Products has moved to 17 East 42nd Street, Corner of Madison Ave., New York, N. Y.

Copper Rod Rolling, Wire Drawing and Annealing

(*Continued from page 337*)

The retort is supported on a framework similar to an elevator, counterweighted and raised by an electric hoist, the car of wire being registered under the retort which is lowered to the annealing position over the pot.

After the annealing period the retort is raised, the car advanced along the track and the gas applied for the cooling period which is usually eight hours.

✦ ✦ ✦

THE values required by the American Society of Testing Materials are as follows:

	Tensile Strength lbs. per sq. in.	Elongation
.460-.290	36,000	35%
.298-.103	37,000	30%
.102-.021	38,500	25%
.020-.003	40,000	20%

✦ ✦ ✦

FROM a series of experiments by annealing in oil the following curves will give the effect of temperature and time on tensile strength, elongation and sclerescope test. (Fig. No. 28).

It will be noted that the point of maximum anneal does not agree with the temperature quoted as the furnace operating temperatures of mass annealing in an atmosphere, partly due to the position of the work in relation to the thermo-couples, so that comparison of results was employed in determining operating temperatures.

✦ ✦ ✦

THE effect of annealing on the crystal structure of the metal will be noted in the accompanying photo micrographs. Fig. No. 29.

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AT BUFFALO, N. Y.
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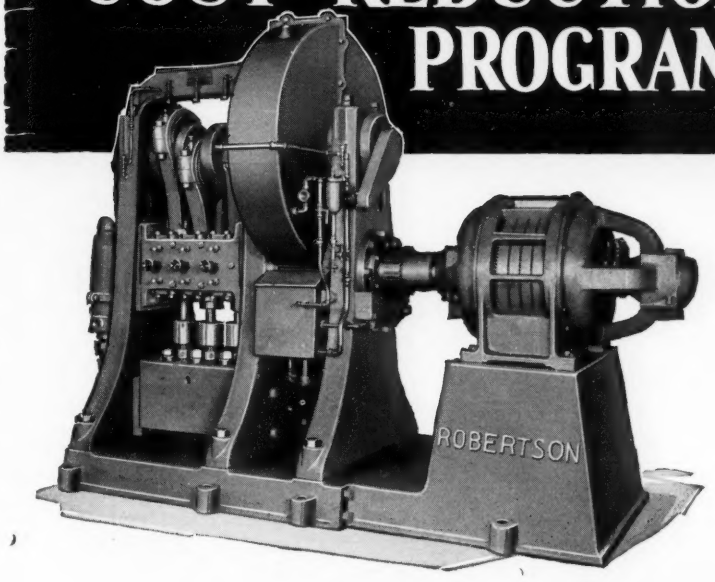

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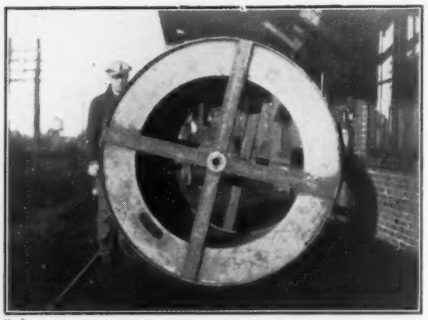

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For High or Low Carbon Wire
WIRE DRAWING SOAPS
Established 25 years.
R. H. MILLER CO., Inc. Homer, N. Y.

PLANT EFFICIENCY

(*Continued from page 356*)

many a purely relative term, but any individual in a responsible position who has employees under his charge from whom he is endeavoring to get the best efficiency cannot fail to be interested in the illumination of the department concerned, as it is definitely known that eye strain has a distinct bearing on the health and vitality of the workmen as well as tending to cause mistakes and errors in comparative judgment. Where there is the definite desire to improve the general health of the workmen there follow closely a more detailed study of the lighting condition, which has a three-fold result of assisting in the reduction of waste, in reducing eye impairment, and the health of the workmen being benefited.

✦ ✦ ✦

I COULD continue relating other phases of personnel work with employees that have a bearing on the efficiency of the plant operation, but I believe the inference, as referred to, is sufficient. There is nothing new in what I have said, it being simply a statement of a few obvious facts that any individual responsible for plant management is usually fully aware of, but you will agree with me in this regard that it is one thing to know and another thing to benefit from the application of the knowledge. I believe there is still much to be done in the way of improving plant efficiency through the use of the more altruistic and humanitarian forces, which are well within our control.

✦ ✦ ✦

Process Control in Manufacture of Rubber Covered Wire

(*Continued from page 349*)

and straining it. Suppose further that the remarks on mixing and straining indicate that nothing unusual happened during these operations, but that the compound record shows that a new lot of some ingredient, for example, reclaimed rubber, was used for the first time in this batch and all the

other ingredients used had been employed in previous batches which gave good electrical properties. Circumstances such as this immediately lead one to suspect the particular lot of reclaimed rubber and steps can be taken directly to substantiate this suspicion. This would include an examination of the records of tests made at the time of inspection of the incoming raw material as well as an inspection of the remainder of the material on hand. If no records such as these were available it might be necessary to investigate many of the compounding ingredients before the particular one responsible for the difficulty was found.

IN a similar way mechanical faults or faults due to poor equipment or poor operation may be readily traced direct to their source through such a system of records and a definitely prescribed operating procedure.

THUS process control records and specifications make easy the location of the sources of trouble. Since the location of the source of trouble is so easy, it is more likely to be located and remedied rather than to be passed over as another occurrence which is "just too bad".

IN addition to the procedure for process control as just outlined other facilities contributing to such control are frequently available in the form of current cost accounting and statistical reports. Such reports of value here are those showing the relation of actual copper, compound, lead, cotton, and saturating and finishing waxes consumed to the theoretically required quantities for the various types of product. Pronounced or continuing variations in these two sets of data indicate that some corrections need be made either in the standards themselves or in the quantities actually used.

PROCESS control in the manufacture of rubber covered wire, and it would not be different for other articles wholly dissimilar in nature, is thus seen to consist, as we see it, in having an expressed plan of procedure arrived at by a careful study and considera-

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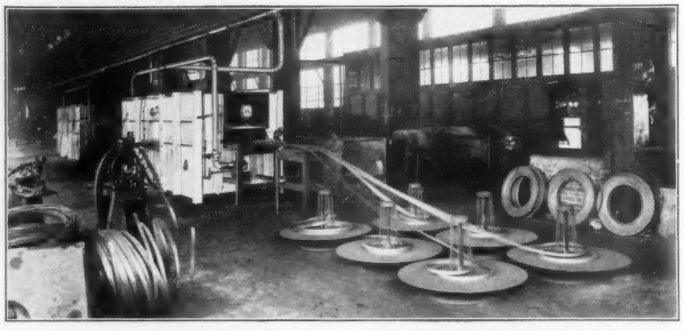

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tion of the process as a whole in advance of actual factory operations, together with an inexpensive system of records and supporting data which will insure the proper execution of that plan at all times.

✦ ✦ ✦

The Production of Stainless Hot Rod

(*Continued from page 354*)

soft. While it is possible to handle the material without alteration of the surface, the chromium scaling is a very indefinite problem. It is usually simpler to pickle the mill scale off before anneal. This can be done in sulphuric acid using about 10% solution by volume with rather high temperature about 165°F. being desirable. The pickling is rather a roughing operation to remove most of the scale. While it is commercially feasible to bright anneal such material, it is more usual to anneal under conditions tht simply keep down the amount of scale. The atmosphere is kept neutral or reducing by keeping the furnace gases under control. The product, when annealed, is usually a sort of bronze colored material. The final scale is best pickled off in mixtures of nitric and hydrofluoric acid, the usual combination being about 10% nitric by volume carrying bout 2% by volume of hydrofluoric. It is an extremely active mixture. The temperature should be low, not over 120°F. and the material kept under constant observation to prevent over-pickling. A more metallic luster is produced when a little hydrochloric acid is added to this mixture. The amount of hydrochloric should be less than 5% and the surface must be watched to prevent etching pits.

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THE chromium nickel steels should be rough pickled in sulphuric. They must then be heated to very high temperature, in certain cases to high speed steel treating temperatures of 2200°F. Usually they develop the proper hardness and structure at about 1850°F. and it is exceptional that they require as much as 2000°F. The scale and risk involved in going higher cause the operator to be very careful when and why

he uses the higher temperatures. The fundamental of this anneal is to produce a single phase. The carbides are put into solution and it is desirable that they be retained. The simplest way to accomplish this is to quench the material. The most desirable method is to anneal the cleaned coil in a dry hydrogen atmosphere and water quench the product. A fairly simple method of handling small lots is to continuously anneal in a metal tube furnace in dry hydrogen. The choice of the proper furnace is governed by the volume of production. Where the bright anneal furnaces are not available the material is heated in an open furnace or muffle and quenched in water. The pickling of the final coil is in mixtures of nitric and hydrofluoric acid as noted before.

✦ ✦ ✦

IF the variables that are known to be present in the process have been understood and controlled, the product is a silvery rod whose surface is very smooth. The internal structure in both materials will be relatively coarse grained compared to high carbon wire. This is not a serious factor. Wire is essentially a fibered material and it is a mistake to attempt the operation on material with too fine a grain. The hot rod of the proper characteristic is a commercial product, is any of several combinations of chemistry. Its production is not confined to any producer. Several very dependable sources exist at this time. It is but reasonable that such organizations that have equipped themselves with men, experience and the proper furnaces, both are for primary melting and induction for remelting of the scrap should be able to serve more advantageously. The problem of purchase of satisfactory hot rods for stainless wire is today a problem of deciding where the most earnest effort is being made to produce the material most desirable for wire drawing.

Machines for Coating Wire with Rubber, Plastic or Flux

▲ ▲ ▲

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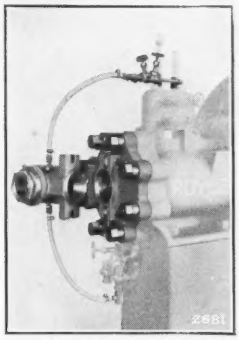
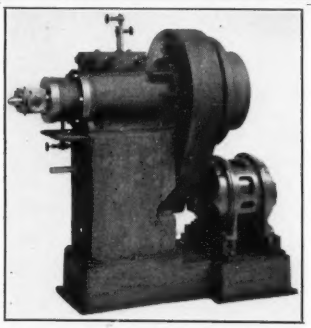


Steam Heated Extruding Head (open) on Royle Tubing Machine



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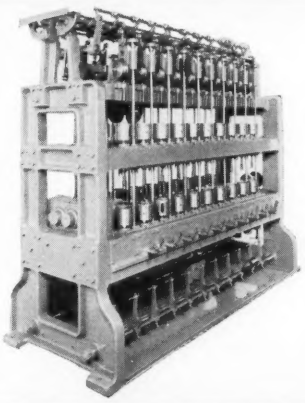

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A Radical Improvement In Tungsten Carbide Dies

(*Continued from page 361*)

ing a soap box out of gold. A very costly material is being used for strictly structural purposes and its structural usefulness ends with the life of the die.

✦ ✦ ✦

THE Master Wire Die Corporation of New York, N. Y., have developed certain patents to the production stage which mark the first really radical step toward lowering the cost of drawing wire with tungsten carbide dies. Under this novel die assembly, the "nib" which must be replaced when worn out is depended upon only for its abrasion resisting qualities, and not for its structural properties. All strictly structural functions are taken care of by permanent structural members requiring no replacement.

The nib is ground to a taper on the outside corresponding to the taper in a casing of tungsten carbide. No pressure other than the wire being drawn is required to seat the nib in the casing. By use of a casing of the same material as the nib, all of the objectionable features of a steel casing are eliminated.

The tungsten carbide casing as shown in the accompanying cut fits into a die holder, which holder is used for water cooling the outside of the casing, for easy attachment to the wire drawing machine, and for the most important function of providing force feed lubrication to the die. This lubrication is easily replacable steel guide silghteffected by an inexpensive, and ly larger in diameter than the incoming wire which spreads lubricant on the wire and builds up a tremendous pressure withe the lubricant in the annular space between the mouth of the die and the incoming wire.

The tungsten carbide nib proper need only be large enough to admit the incoming wire. It is easily removed from the casing when worn beyond tolerance limits and a new nib inserted.

✦ ✦ ✦

TRANSLATED into terms of cost a die nib weighing ten grams solid, may be used to break

down No. 5 Rod of high carbon steel without loss of casing when replaced, which work under the present practice would require a nib with a solid weight of 53 grams at a cost for casing of about $2.00. The tungsten carbide casing and the steel holder being permanent fixtures contribute very little to the die cost.

Within the ranges of sizes below the No. 5 Rod breakdown, which is practically the entire wire business, tungsten carbide die costs are reduced about 70% with the added advantage of guiding the wire centrally into the die thus assisting in obtaining the desired physical properties in the wire. This sounds like progress.

✦ ✦ ✦

New Type Butt Welders

A NEW production butt welder with automatic features that make it especially desirable for use in connection with high speed, continuous, multiple block drawing machines, where clean, sound welds are necessary to eliminate breakage. Its fast action and these automatic features make it a practical machine for stranding, spooling and fabricating operations in wire mills and wire working plants.

All operations, including clamping the stock, contacting the operating switch, and upsetting the weld are accomplished by a single downward stroke of the foot pedal. When the weld is completed, the foot pedal is returned to the operating position by a coil spring, which action releases the welded material from the dies and automatically respaces and resets the dies in position for the next weld, leaving the operator's hands free during the entire operation to handle the material.

The machine functions as a flash welder, and not only utilizes the flash to heat the rod or wire ends, but also to create an atmospheric condition around the weld that prevents occlusion of gases, making instantaneous, oxide-free welds possible, with a minimum of annealing.

General construction throughout is rugged and ample, the frame work being constructed of rolled steel plates, arc welded together, which provides maximum rigidity without extra weight. Welding headpieces are made from hard bronze. A heavy duty heat switch provides six steps of heat. The clamping mechanism is arranged to provide a powerful grip that eliminates any possibility of slipping during the upsetting operation.

Current control is entirely automatic, the operating switch being contacted by the foot pedal action, after proper pressure has been applied, and an adjustable limit switch is provided to cut off the current just before the weld is completed.

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Buffalo, N. Y., October 3-7, 1932

The Wire Association,
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Please reserve ..... copies of the official proceedings of the Annual Meeting and Exhibit at Buffalo, N. Y., October 3-7, at $2.50 each, payable after delivery.

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BUYERS' GUIDE

For more complete information, consult the annual Directory, Index & Buyers' Guide.

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See Furnaces—Various Headings

ANNEALING POTS AND BOXES
National Wrought Iron Annealing Box Co., Washington, Pa.
Scudder, E. J., Fdry & Machine Co., Trenton, N. J.

ARMORING EQUIPMENT
Amer. Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

BAKERS
Morgan Construction Co., Worcester, Mass.
Niagara Blower Co., Buffalo, N. Y.
Vaughn Machinery Co., Cuyahoga Falls, O.

CASTINGS—Wire Mill
E. J. Scudder Foundry & Machine Co., Trenton, N. J.

CHROME NICKEL—Construction
National Wrought Iron Annealing Box Co., Washington, Pa.

CLEANING & PICKLING EQUIPMENT
Broden Construction Co., Cleveland, O.
Fred'k M. Conran, Newark, N. J.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

COILERS—Sheet and Wire
H. J. Ruesch Machine Co., Newark, N. J.

CRANES—Wire Mill
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

DIES—Composition
Diamond Die Co., of America, New York, N. Y.
Vianney Wire Die Works, New York, N. Y.

DIES—Diamond
Balloffet Diamond Wire Dies Co., Inc., N. Y. C.
Cochaud Wire Die Co., New York.
Diamond Die Co., of America, New York, N. Y.
Driver-Harris Co., Harrison, N. J.
Vianney Wire Die Works, New York.

DIES—Lead Extrusion
John Robertson Co., Brooklyn, N. Y.

DIES—Repairs & Re-Cutting
Balloffet Diamond Wire Dies Co., Inc., N. Y. C.
Cochaud Wire Die Corp., New York.
Diamond Die Co., of America, New York, N. Y.
Driver-Harris Co., Harrison, N. J.
Firth-Sterling Steel Co., McKeesport, Pa.
William Haddow, Ossining, N. Y.
Vianney Wire Die Wks., N. Y.

DIES—Recutting and Repolishing Machine
Wm. Haddow, Ossining, N. Y.
Vianney Wire Die Works, New York, N. Y.

DIES—Rod and Tube Drawing
Carboloy Co., Inc., Newark, N. J.
Firth-Sterling Steel Co., McKeesport, Pa.
Master Wire Die Co., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.

DIES—Tantalum Carbide
Diamond Die Co., of America, New York, N. Y.
Vianney Wire Die Works, New York, N. Y.

DIES—Tungsten Carbide
Carboloy Co., Inc., Newark, N. J.
Driver-Harris Co., Harrison, N. J.
Master Wire Die Co., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.

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Scudder, E. J., Fdry & Machine Co., Trenton, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.

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W. S. Rockwell Co., New York, N. Y.

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Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

LIME—Pulverized
Amer. Lime & Stone Co., Bellefonte, Pa.

LUBRICANTS—Wire Drawing
J. T. Robertson Co., Inc., Syracuse, N. Y.
R. H. Miller Co., Homer, N. Y.

MACHINE—Die Re-cutting and Polishing
Wm. Haddow, Ossining, N. Y.

MACHINERY—Armoring (Cable, Wire Hose)
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
John Robertson Co., Brooklyn, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
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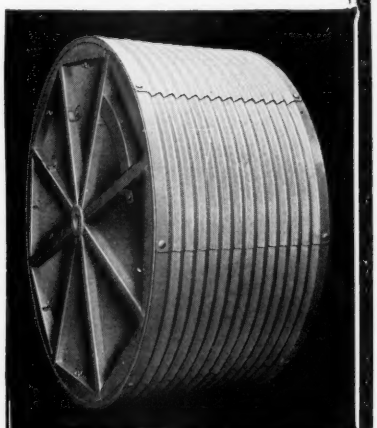

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New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

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Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.

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New England Butt Co., Providence, R. I.
Watson Machine Company, Paterson, N. J.

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Vaughn Machinery Co., Cuyahoga Falls, O.

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Watson Machine Co., Paterson, N. J.

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Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

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Vaughn Machinery Co., Cuyahoga Falls, O.

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Broden Construction Co., Cleveland, O.
F. B. Shuster Co., New Haven, Conn.
Sleeper & Hartley, Worcester, Mass.

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MACHINERY—Extruding
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John Royle & Sons, Paterson, N. J.
Watson Machine Co., Paterson, N. J.

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Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Forming
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Morgan Construction Co., Worcester, Mass.
Sleeper & Hartley, Inc., Worcester, Mass.
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Watson Machine Co., Paterson, N. J.

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New England Butt Co., Providence, R. I.
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MACHINERY—Lead Stripping
John Robertson Co., Brooklyn, N. Y.
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Sleeper & Hartley, Inc., Worcester, Mass.

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Sleeper & Hartley, Inc., Worcester, Mass.

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Watson Machine Co., Paterson, N. J.

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Vaughn Machinery Co., Cuyahoga Falls, O.

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Morgan Construction Co., Worcester, Mass.
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Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdy. & Machine Co., Waterbury, Conn.

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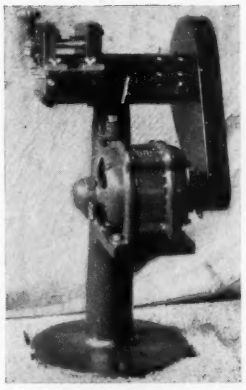
Fred'k M. Conran, Newark, N. J.
Morgan Const. Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.

RUESCH



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H. L. Reusch Machine Co., Newark, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farel Fdy. & Machine Co., Waterbury, Conn.

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Watson Machine Co., Paterson, N. J.

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Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdy. & Machine Co., Waterbury, Conn.

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PRESSES—Lead Encasing

John Robertson Co., Brooklyn, N. Y.

PRESSES—Lead Extrusion

John Robertson Co., Brooklyn, N. Y.

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ROLLING MILLS—See Machinery—Rolling Mill

SOAPS—Wire Drawing

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Robertson Co., J. T., Inc., Syracuse, N. Y.

STEEL PLATE CONSTRUCTION—

National Wrought Iron Annealing Box Co., Washington, Pa.

TANKS—Compound

Watson Machine Co., Paterson, N. J.

TANKS—Steel Plate

National Wrought Iron Annealing Box Co., Washington, Pa.

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Vaughn Machinery Co., Cuyahoga Falls, O.

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VULCANIZERS

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Watson Machine Co., Paterson, N. J.

VULCANIZING PANS

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WIRE—Enameled For Coils

Winsted Insulated Wire Co., Winsted, Conn.

WIRE—Nickel Silver and Phosphor Bronze

Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.

WIRE—Various Kinds

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Seymour Mfg. Co., Seymour, Conn.
Winsted Insulated Wire Co., Winsted, Conn.

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Statement of ownership, management, circulation, etc., required by the Act of Congress of August 24, 1912, of Wire & Wire Products published monthly at Washington, N. J., for October 1, 1932.

State of New York, County of New York, ss.: Before me, a Notary Public in and for the State and county aforesaid, personally appeared R. S. Spengel, who, having been duly sworn according to law, deposes and says that she is the Secretary-Treasurer of Wire & Wire Products and that the following is, to the best of her knowledge and belief, a true statement of the ownership, management, (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

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Publisher, Quinn-Brown Publishing Corporation, 17 East 42nd St., N. Y. City; editor, Richard E. Brown, 17 East 42nd St., N. Y. City; managing editor, none; business manager, Richard E. Brown, 17 East 42nd St., N. Y. City.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.) Quinn-Brown Publishing Corporation, 17 East 42nd St., New York City, Jennie R. Baker, Hammonton, N. J., and Leta B. Brown, of 17 East 42nd St., New York City.

3. That the known bondholders, mortgagees, and other security holders owning or holding one per cent of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has interest direct or indirect in the said stock, bonds, or other securities than as so stated by her.

R. S. SPENGEL
(Secretary-Treasurer)

Sworn to and subscribed before me this 21st day of September, 1932.

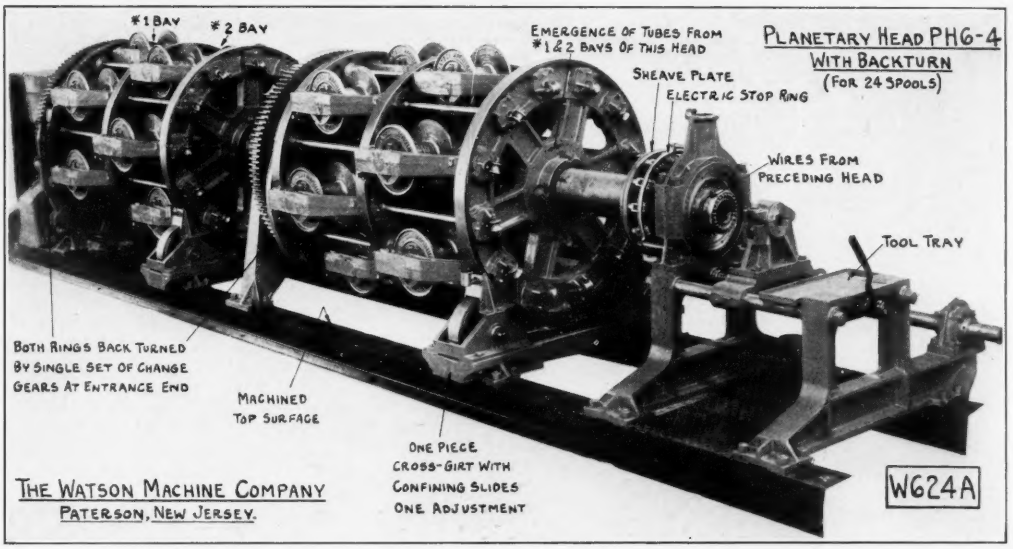
(SEAL) L. D. SCHWAERER,
Notary Public.

THE WATSON MACHINE COMPANY

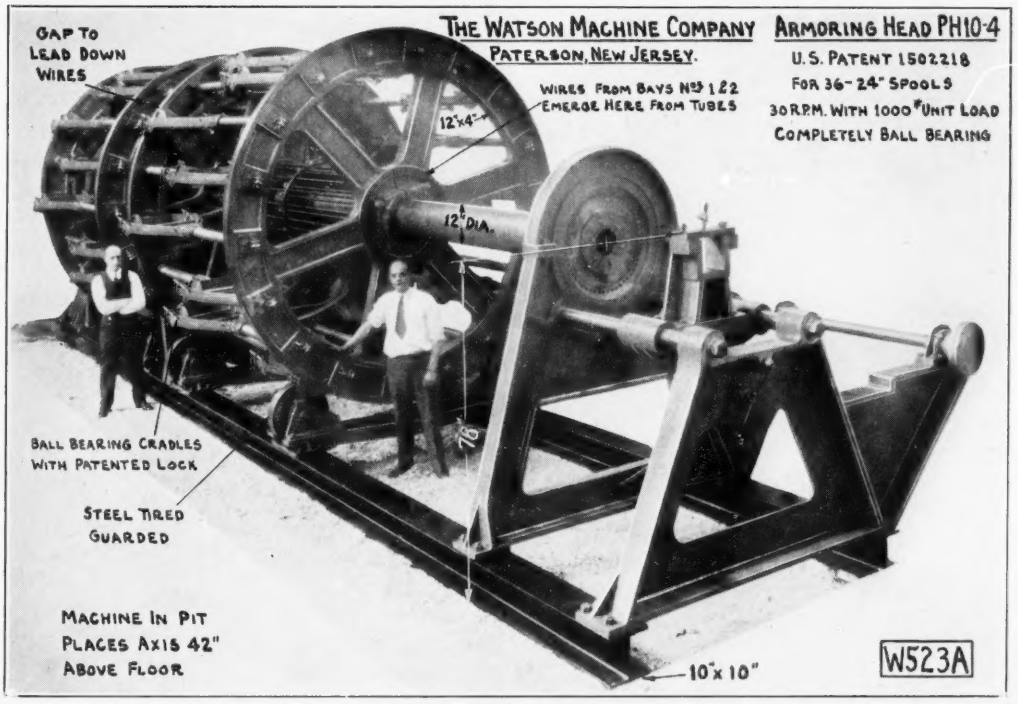
ESTABLISHED 1845

PATERSON, NEW JERSEY, U. S. A.

ENGINEERS - FOUNDERS - MACHINISTS


#1 BAY
#2 BAY
EMERGENCE OF TUBES FROM #1 & 2 BAYS OF THIS HEAD
PLANETARY HEAD PH6-4
WITH BACKTURN
(FOR 24 SPOOLS)
SHEAVE PLATE
ELECTRIC STOP RING
WIRES FROM PRECEDING HEAD
TOOL TRAY
BOTH RINGS BACK TURNED BY SINGLE SET OF CHANGE GEARS AT ENTRANCE END
MACHINED TOP SURFACE
ONE PIECE CROSS-GIRT WITH CONFINING SLIDES ONE ADJUSTMENT
THE WATSON MACHINE COMPANY
PATERSON, NEW JERSEY.
W624A

PLANETARY HORIZONTAL STRANDING HEADS in 100, 250 and 500 pound series; for 6, 12, 18, 24, 30 and 36 spools in each series. All Anti-Friction Bearings (including Cradle Necks), with positive elimination of spool side-slap allowing highest speeds. Automatic stops and brakes, low wire lead angles, positive locks preventing operation with unlocked spools. Lang lay attachment at low extra cost.


GAP TO LEAD DOWN WIRES
THE WATSON MACHINE COMPANY
PATERSON, NEW JERSEY.
ARMORING HEAD PH10-4
U.S. PATENT 1502218
FOR 36-24" SPOOLS
30 R.P.M. WITH 1000# UNIT LOAD
COMPLETELY BALL BEARING
WIRES FROM BAYS Nos 1 & 2 EMERGE HERE FROM TUBES
12"x4"
12" DIA.
BALL BEARING CRADLES WITH PATENTED LOCK
STEEL TIRED GUARDED
MACHINE IN PIT PLACES AXIS 42" ABOVE FLOOR
10"x 10"
W523A

PLANETARY HORIZONTAL ARMORING HEADS in 500 and 1000 pound series, for up to 54 spools in each series. Same construction as on Stranding Heads.

ELECTRICAL WIRE AND CABLE, WIRE ROPE AND CORDAGE MACHINERY

means saving

Every manufacturer is faced today with the problem of making a profit... at present prices. This means reducing the cost of manufacture.

We have been called into many conferences of late to see if we could suggest a less expensive wire for the purpose in question. In many cases, we showed the user how he could, by employing a more uniform grade wire, speed up his production and enjoy savings in labor, tools and overhead far in excess of the cost of the wire itself.

Wickwire Spencer Engineers will be glad to study your product and production. They are trained to go more deeply into the subject of wire product manufacturing than does the usual commodity salesman. Their services are free ... yours for the asking. Write or telephone the nearest Wickwire Spencer office. Your inquiry may be the means of SPEEDING you on your way to profits.

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Wickwire Spencer Steel Company, 41 East 42nd Street, New York City; Buffalo, Chicago, Detroit, Philadelphia, Tulsa, Worcester; Pacific Coast Headquarters: San Francisco; Warehouses: Los Angeles, Portland, Seattle. Export Sales Department: New York City

WISSCO WIRE

by Wickwire Spencer

Wickwire Spencer manufactures High Carbon Wires—in various tempers, grades and finishes—for your specific purpose. Hard-Drawn annealed, or oil-tempered Spring Wire, Chrome Vanadium Spring Wires—Valve Spring—Music—Machinery Spring Wire—Clock Spring Steel—Stainless Steel Spring Wires, both drawn and tempered. Consult the Wissco technical man on your spring wire problems, however large or small.